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The Journal of Bone & Joint Surgery

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For the British Orthopaedic Association

Editorial Secretary,—H. Platt, M.S., F.R.C.S., 26 St. John Street, Manchester, England.

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R. C. Elmslie, M.S., F.R.C.S.
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For the American Orthopedic Association

Editor,—E. G. Brackett, M.D., 166 Newbury Street, Boston.

Committee,—
J. L. Porter, M.D.
E. W. Ryerson, M.D.
R. B. Osgood, M.D.

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VOL. V, No. 1 JANUARY, 1923 Old Series: Vol. XXI, No. 1

The Journal of Bone & Joint Surgery

OSTEOCHONDRITIS DISSECANS.*

BY ALBERT H. FREIBERG, M.D., CINCINNATI, OHIO.

THE disease of joints which was first described under this name by Koenig, in 1888, has become of ever increasing interest during the past ten years. The article by Freiberg and Woolley, published in 1910, was the first in the English language, so far as I have been able to ascertain. Since this time quite a few papers have appeared upon this subject, notably those of Ridlon, Brackett and Hall, Colvin, and others. For the most part, with the exception of those named, the discussion has involved this disease simply as one of the factors concerned in the production of loose bodies in joints, rather than as a clinical entity. Largely as the result of the routine study of abnormal joints by means of the x-ray, it has become apparent that we must look upon this disease as a typical joint lesion apart from its effect of producing loose bodies; the accumulation of clinical evidence and the results of operative experience seem, moreover, to show that some of our conclusions cannot be justified in respect of its etiology and essential nature.

The disease is not frequent, even though far from rare, since the series of Brackett and Hall, which comprises nine cases, is perhaps the largest one reported. Most of these cases involved men whose occupation was

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

presumed to render them liable to trauma of the knee; all of the cases involved this joint and in all the affection was unilateral. The history of the trauma is practically always indefinite; the injury to which the beginning of the disease is ascribed is most often not a severe one and in many cases trauma is rather assumed than known. In Colvin's series of four cases trauma is definitely shown in none. In all of the reported cases which belong without question in this category, the joint is described as free from other evidences of disease. On the other hand, cases are reported in which symptoms of loose bodies recurred after operation; several cases of the involvement of the second knee may be found and several instances are given in which the elbow has been the seat of this lesion in a typical manner. The occasion for this paper is an experience with five cases which it has been possible to investigate with care and in the light of previous observations; each case is presented in relation to certain features of especial interest in the study of the subject in general. I find it impossible to proceed with the account of these cases and the discussion of their practical bearings without paying a tribute of admiration to the great surgeon, Franz Koenig, to whose remarkable clinical acumen and scientific attitude we owe our first acquaintance with this interesting lesion. Let us not fail to remember that he was without the aid of the x-ray and that in his era the opening of the large joints was a very different matter from that of today. I cannot refrain from translating his words:

"Those loose bodies which are formed in a joint, for the most part gravely diseased, stand in diametric contrast to such whose genesis is to be ascribed to an entirely circumscribed disease of the joint ends, which has been described as osteochondritis dissecans.

"Without any injury, there separate from the joint ends fragments of varying size, in consequence of a process as yet unexplained; their bony surface becomes covered with a dense connective tissue containing cartilage cells, here and there. In the same manner the defect in the bone becomes covered over. In some cases a smaller body composed entirely of bone and smooth with the appearance of necrotic bone, lay under a larger piece perhaps 2 cm. in diameter. These pieces often fitted almost exactly in the corresponding bone defect, seeming at times somewhat too large because the pits in the bone had become filled in. Aside from this, together with a fluid effusion and slight villous hypertrophy, these joints looked perfectly sound and they remained so after the removal of the loose bodies." (Allgem. Chir., 1889, p. 751.)

Case 1.—A lady of 49, previously in perfect health, began to experi-

FIG. 1.—CASE 1.

ence discomfort in the left knee in the spring of 1917. She remembered having a sudden twinge in the joint while in a gymnastic class and from this time until after operation the knee was never normal, the chief complaint being inability to completely extend. It is absolutely certain that there was no injury to the joint beyond that mentioned and I feel sure of the reliability of the statement. When examined in November, 1917, there was no swelling of the knee and no tenderness on pressure. Motion was free in flexion, but extension was limited by about ten degrees and there was a definite limp; after walking a short distance the joint became painful. For about two weeks before operation there had been often a sensation as if something had slipped out of place. Examination on November 16 showed full motion in extension and the x-ray was made on this day. (Fig. 1.) This showed the joint to be perfectly normal except for the typical lesion in the internal condyle of the femur; a niche containing an apparently loose piece of bone, and two small fragments of bone in the joint line just above the tibial spine. It seemed likely that the movement of this small piece was responsible for the hindrance to extension which had been present most of the time during the preceding six months.

On November 20, 1917, the joint was opened by internal oblique incision; the large loose body was found lying in its niche in the internal condyle and two smaller ones were found attached to it by a slender pedicle about 2.5 cm. long, so that the three pieces came out together. Recovery was uneventful and the function of the joint has been perfect ever since.

COMMENT.

The assumption of direct traumatic origin in this case would be entirely gratuitous; it is apparent that the first symptom was produced by movement of a small body already free at that time. There is no way of ascertaining how long the bodies had been loose or when the separation began. In this knee the spine of the tibia is not abnormally long. Finally, there would seem to be no reason for choosing the transpatellar method of arthrotomy in such a case.

CASE 2.—A school girl, seventeen years old, the daughter of well-to-do parents, was examined in July, 1916, because of trouble with the left knee. Almost one year before, this knee had been injured in a hockey game. About one month after this injury, which was not severe, she had pain in the joint and there was water in the knee. This subsided and the knee gave her only occasional slight discomfort until one month before I examined her when she injured the knee alighting from a street car; she was unable to bend her knee for a day and an effusion was apparently present for a time. There was a limp from this time on and a sensation of something slipping several times daily. My examination showed no effusion or muscular atrophy and there was no limitation of motion; during my examination she felt something slip in the joint. There was some tenderness on the mesial side of the knee. The

FIG. 2.—CASE 2. Note the long mesial tubercle of the tibial spine.

x-ray (Fig. 2.) showed a loose body, about 1.5 cm. long, lying in a niche in the mesial condyle of the femur; no second loose body can be seen. The mesial tubercle of the tibial spine is very long, but the joint appears otherwise normal. The loose body was removed by internal oblique incision; it lay in its niche and there was a slender pedicle. The body was half again as large as it appears in the x-ray by reason of its connective tissue covering. Recovery was uneventful and this knee has remained perfectly well.

I saw this patient again in 1920 because of trouble with the other knee. In 1918, while I was in military service, she had symptoms appear in the right knee like those which she had experienced in the left. There had been no trauma to this knee so far as she knew. The surgeon who was consulted made the diagnosis of osteochondritis dissecans, with two loose bodies, and they were removed by arthrotomy. She consulted me because the symptoms in this knee had recurred and the x-ray which she brought showed a loose body about 0.5 cm. long, in the joint line. The remains of the defect in the condyle could be made out, though indistinctly, and there was no evidence of recent bone loss at this place. For reasons of no present interest I did not have the opportunity to operate upon this joint and the x-ray of the right knee was not left with me.

COMMENT.

Like my first case, reported in 1910, this case presents the interesting involvement of the second knee without demonstrable trauma and likewise the recurrence of symptoms in the second knee after operation under circumstances which make it probable, at least, that a loose body had been left behind. The length of the mesial tubercle of the tibial spine also seems worthy of attention. The particular interest in this case lies in the behavior of the second knee; the recurrence of symptoms after operation makes it seem possible that there had been formed an additional loose body. This is rendered unlikely by the fact that the first knee has remained well and that there was no evidence in the x-ray of the second knee that any further change had occurred at the site in the mesial condyle. While the niche was still easily to be seen, it was smooth with well rounded edges. In this case, also, I feel sure that a careful study of the radiogram before operation would have revealed the presence of the third loose body which was responsible for the recurrence; were it so small as to preclude this, I doubt the likelihood of finding it by the transpatellar operation. At the same time, it is possible that its situation, had it been seen, would have been such as to make this the desirable method of entering the joint.

CASE 3.—For the privilege of reporting this case I am obliged to Dr. Howard A. Smith, of Marietta, O. The patient is a young man who was examined for disability incident to military service. When 14 years old this knee was locked several times with a period of soreness following. He had attacks of locking once or twice a year up to the time of entering service. At that time the knee was examined, but nothing definite was found, and no x-ray was made. While overseas he had a fall in the trenches and the knee now became continuously troublesome, so that it was opened at Camp Sherman and two loose bodies were removed. Since then there has been much soreness and stiffness and occasionally swelling with effusion, but no locking. At the present time he is practically free from symptoms. The x-rays (Fig. 3.) show the

FIG. 3.—CASE 3. Long mesial tubercle.

typical niche in the mesial condyle, about 2 cm. wide and occupied by a body measuring about 1.5 x 1.0 cm. There is also a shadow in the posterior part of the joint which might be taken for a loose body, especially in the lateral view; it is apparent, however, that this is the fabella or gastrocnemial sesamoid. It is found in the typical situation, behind the external condyle, in the antero-posterior view. Attention is called to the long internal tubercle of the tibial spine; in the affected knee it appears to impinge upon the femur. While it is quite long in the normal (right) knee, there is no such appearance of impingement.

COMMENT.

In this case, also, we have recurrence of symptoms after operation; there was, however, an injury which might be held to account. It is unfortunate that we have no information of the precise nature of operation and its findings. At the same time it appears likely that the loose body at present to be seen was in existence at the time of operation and perhaps even from childhood, but that it was either not sought for or was not found. In any event, this case shows the need for most careful study of the x-ray before proceeding with operation.

CASE 4.—A man 28 years old presented himself in February, 1920, because of trouble with the left knee; he had known for some years that this joint was not normal. His occupation is mercantile, but he has always indulged in strenuous athletic sports and has had numerous injuries, but no serious ones, and he could remember none affecting this joint especially. During the past year the left knee had frequently annoyed him by reason of stiffness and he had several attacks of locking. Examination showed some muscle atrophy in the thigh, slight limitation of extension of the knee, slight capsular thickening and some tenderness over the front of the joint and mesially. There was no fluid effusion at this time. X-rays (Fig. 4) showed a large typical defect in the

FIG. 4.—CASE 4. February, 1920.

internal condyle of the femur, containing a spongy looking fragment; in the lateral view, made somewhat obliquely, there appeared a dense nucleus or smaller fragment about 0.5 cm. long lying in the niche. In this view there was also seen a larger dense shadow, above the patella, about 2.2 cm. long. Both tubercles of the tibial spine seemed noticeably long. Operation was proposed, but was declined at this time.

In March, 1921, more than a year later, I saw him again. He had wrenched his knee two days before and the joint was now very painful and distended with fluid. He had had numerous attacks of locking and had often felt a movable body in the upper recess on the inner side of the joint. X-rays (Fig. 5) now showed two large loose bodies; one of spongy structure behind the patella in the lateral view and about 2.2 cm. long, and one of dense character in the joint line, 1.5 cm. in length. This dense body seemed to me to doubtless represent the original dense nucleus which had increased in size about four times during the year which had elapsed. After ten days of recumbency, during which the effusion was almost entirely absorbed, operation was undertaken. Immediately before taking him to the operating room a third pair of x-rays was made (Fig. 6), which showed both bodies in the upper recess on the fibular side of the joint. Care was taken to prevent any motion of the joint before the incision was made. The joint was opened in the fully extended position, above the patella and on the outer side. Both bodies were easily found and removed. Both were about twice as large as the x-ray shadows had indicated. Recovery was uneventful and the joint has remained perfectly well during the year which has passed since operation.

COMMENT.

In this case it is more than likely that trauma played an influence in the etiology. The simpler method of opening this joint seemed justified by reason of the fact that the niche in the condyle appeared entirely empty in the preoperative x-rays. Otherwise the transpatellar incision would have seemed proper. During the year which had elapsed after the first examination, both bodies had evidently lost their attachment to their bed of origin and had become freely movable; during the ten days which had passed between taking the second and third sets of x-rays, the bodies had completely changed their position, but we succeeded in maintaining them where last shown immediately before incision was made. There is no question, in my mind, that the dense nucleus increased greatly in size after it had become separated from its bed and within a period of one year.

FIG. 5—CASE 4. March 19, 1921.

FIG. 6.—CASE 4. Day of operation.

CASE 5.—On March 31, 1921, I examined a boy 16 years old because of trouble with his right elbow. It began several months before with stiffness which had been steadily growing worse. He knew of no injury to which the condition could be attributed. He has had no pain excepting during one night, several weeks before I saw him. Some time before that he had struck his elbow and it had been very painful for a short time, but this was long after the beginning of the trouble. He had been examined by another surgeon and told that the elbow was tuberculous. Examination showed the elbow thickened on the radial side and the head of the radius seemed unduly prominent. The elbow could not be extended beyond 110°, although flexion was entirely free. A firm, rather elastic and slightly movable mass could be felt between the external condyle of the humerus and olecranon. A number of x-rays were made which showed an excavation in the external condyle of the humerus, about 1.5 x 0.4 cm., containing a mass of bone of lesser density (Fig. 7). This mass had evidently moved somewhat from its original

FIG. 7.—CASE 5.

position. The diagnosis of osteochondritis dissecans was made and arthrotomy was done April 11, 1921. Incision was made between the olecranon and external condyle. The loose body came into view at once; it was attached by a slender but firm pedicle which had to be cut. The body felt elastic to the finger and was much larger than had been antici-

pated, measuring 3.0 x 2.0 cm. The microscopic examination of this body was of interest in that the bony nucleus seemed to show living bone cells. The elbow has remained well.

COMMENT.

The interest in this case lies chiefly in the fact that it demonstrates definitely the occurrence of osteochondritis in the elbow-joint in a perfectly typical manner.

Most writers on this subject have treated osteochondritis dissecans simply as a phase of the larger matter of loose bodies in joints, rather than as a disease *sui generis;* the reason is rather obvious since most often the symptoms which bring the patient are those of an already liberated loose body. Although Koenig's contention was to the contrary from first to last, there have always been a number who have strenuously insisted upon a traumatism, more or less direct, as the cause. This explanation surely seems the most obvious of any and especially if we are prepared to look upon the trauma as of indirect character. In the face of the very indefinite histories of trauma which we find in nearly all of the cases, and in view of the exceedingly well protected situation in which the lesion is nearly always found, this must be so, of necessity. The force which would result in the breaking out of a segment of the internal condyle of the femur near the intercondylar notch, or of the capitellum humeri, would have to be great beyond the possibility of doubt in the individual case; yet these are the situations in which the condition is seen, almost without exception. On the other hand, we have no record of a kindred process in wrist or ankle; joints which are very commonly and easily subjected to trauma, both direct and severe out of all proportion to anything found in the great majority of the cases with which our discussion is concerned. While not a few cases have been reported in persons who work in a kneeling position, or whose joints may be presumed to have been subjected to severe stresses either in work or play, the history of trauma is most indefinite in an overwhelming majority. The incidence of the condition in the second knee of the same individual in quite a number of instances presents itself as another point arguing for some local peculiarity as a necessary factor. Ludloff reported cases in which it was possible, by means of the x-ray, to recognize the condition so early that when the joint was opened, it was found that the cartilaginous covering of the fragment had not yet become separated from its surroundings and had to be circumscribed by an incision in order to liberate and remove the

bone fragment. I have had this experience in a woman of 50, within the past year; I have not included this case in this series because the x-ray showed evidence of chronic arthritis. As in Ludloff's cases, there was found on the internal condyle of the femur a bluish looking spot in the cartilage which seemed yielding under pressure of an instrument; incision of the cartilage liberated a typical fragment of bone about 1.0 cm. long and 0.3 cm. thick. In this case there was a history of a severe blow against a table about one month before I saw her.

The x-ray appearances of these cases would seem to be very characteristic and significant. The invariable situation on the internal condyle of the femur, the separation of bone leaving a niche in the condyle always of the same general shape and varying only in size, the phenomenon pointed out by Ludloff, all point to some peculiarity of the local circulation as the fundamental factor. The process seems almost inevitably akin to that of infarction as we see it in kidney, spleen, and brain; true, it is not wedge-shaped as are these, but this can be explained by the peculiarity of the local arterial supply to be later referred to. In three of my cases it has been possible to see x-rays of the joint made one year or more after operation; the niche in the bone, while smoothed off at the edges, could be easily seen. This seemed to speak for a peculiar condition of the local circulation; the defect should otherwise have become filled in. In 1908, Ludloff sought to explain the nature of this peculiar disease by a study of the circulation of this part of the knee-joint. He called attention to the work of Lexer, who showed that in childhood the epiphyses of the long bones abound in arteries which are terminal in the same sense that we use this term in viscera, such as kidney, brain, and lung; viscera in which we frequently find the lesion spoken of as infarction. Furthermore, that as development progresses, anastomoses develop quite generally, so that few, if any, vessels may remain as terminal. In the knee, he calls attention to an artery, the arteria genu media, which ramifies over the posterior crucial ligament and the internal condyle of the femur. This artery is frequently a terminal vessel and its blocking could easily explain the occurrence of such a circumscribed necrotic process as we are at present concerned with. Ludloff believed that by simultaneous hyperextension and inward rotation of the joint this vessel would be susceptible of damage by internal trauma. Force of any consequence exerted in this position would, however, be most unusual and could scarcely escape remark. Rieger (*Münch. med. Woch.*, June 15, 1919) observes that fat embolism of terminal vessels in the ends of femur, humerus, and other long bones

has been determined at autopsies. In adults, these terminal vessels run in fat cells, whereas in children they run in connective tissue. He thus explains the failure to observe this condition in children. Granting this, we should, however, be at a loss to explain the occurrence of embolism in these vessels without admitting either an infective or traumatic factor. Of these two, the traumatic would seem much more likely in joints which appear to be in every other respect entirely normal, or at least free from evidence of any other infectious or inflammatory process.

The examination of the radiograms of many knee-joints will show that considerable variations in the formation of the tubercles of the tibial spine are to be observed. Not infrequently they are seen to be much longer than usual, even in the absence of any other visible abnormity in the radiogram. In three of the cases reported here unusual length of these tubercles was evident, and in two of them the internal tubercle was much the longer. For this reason, it seemed worth while to investigate this factor in the cadaver. For this purpose, I was fortunate in securing the coöperation of Dr. Karl Little, Director of the x-ray laboratory of the Cincinnati General Hospital, and Dr. O. V. Batson, Assistant Professor of Anatomy in the University of Cincinnati. The knees of a number of cadavers were first x-rayed by Dr. Little, in order to determine the character of the tibial spines. The knees were then frozen and sawed in coronal section so as to cut through the tibial spine. It was found quite easy, even where the tubercle was not long, to make it impinge upon the posterior crucial ligament when the knee was *flexed and the tibia rotated outwards.* This is just the reverse of the position spoken of by Ludloff. Where the tubercle is long the impingement occurs much sooner, and it seems easily conceivable that it might take place with enough force to damage a small vessel were this to be found just in the right place. The task of producing a vascular blocking in just this situation in the living animal has thus far seemed impossible of accomplishment, and we are, therefore, without further experimental evidence. The position of flexion and external rotation of the tibia is at least one in which the knee is frequently subject to functional trauma, and this observation is therefore simply presented without further comment. While it is conceivable that blocking of a terminal vessel in this situation may occur by reason of embolism, septic or other, just as happens in the viscera, we are without evidence of it in any instance; the endarterial changes described by Freiberg and Woolley in 1910 were, moreover, of inconclusive character. For the present, at least, it would seem as if we

must look upon this interesting condition as the result of trauma, perhaps, but only as an indirect result. The rarity of the lesion is probably to be explained by the necessary concomitance of the several elements:

(a) the existence at this point of terminal arterioles;

(b) a long tubercle of the tibial spine;

(c) internal trauma, occurring in the position of flexion and outward rotation of the tibia on the femur.

There is little need to speak at length of the treatment. Arthrotomy with the removal of *all* loose bodies is our only resource. There is no evidence that further formation of loose bodies ever occurs if the original ones have been removed. This will be most certain if the diagnosis be established early; that is, before the bodies have wandered from the niche in the condyle. We have here another argument for the need of the x-ray in every joint lesion of subacute or chronic character; only thus can identification be made before locking has occurred or a loose body been felt at a point distant from its bed. Experience has shown that for quite a time the loose bodies are attached by a pedicle. Operation thus early may be simple and consist of a short incision, as for loose meniscus. Once the bodies have wandered, the procedure will have to be adapted to the circumstances. It may be desirable to use the transpatellar incision of Jones. I am by no means convinced, however, that this is to be adopted as routine; not because I fear the wider opening of the joint, nor yet because it implies a longer and more severe procedure and more protracted convalescence. It is rather because I believe that, in spite of its admirable exposure of the joint, a small body might nevertheless escape detection. In addition I have to record one instance in which, notwithstanding perfect wound healing, there ensued a degree of bone proliferation on the posterior aspect of the patella which has constituted a permanent limitation of flexion movement. While it is true that I was dealing with a chronic arthritis in this case and not with osteochondritis dissecans, the experience has given me food for thought concerning this more complicated form of arthrotomy, useful though I know it to be.

DISCUSSION OF PAPER BY ALBERT H. FREIBERG, M.D.

DR. H. W. MEYERDING, Rochester, Minn.: Dr. Freiberg has covered the subject in his usual thorough manner. As the hour is late and the time limited, I shall show a few x-ray slides and be as brief as possible in my discussion.

I do not believe that we can entirely discard the theory of trauma as an etiologic factor, whether intrinsic or extrinsic. It has been my personal

experience, and, I believe, the experience of others, to have seen patients who have given a clear history of distinct trauma to the knee joint, followed by the formation of loose bodies. These bodies frequently are attached, and at times, as illustrated in slide one, show the cartilage merely cracked loose and lying in its normal position, yet giving rise to pain and discomfort without locking. Later, these bodies, by repeated trauma from joint action, etc., become loose and are still attached by a pedicle. If the border of the cavity from which the body has loosened itself is irregular, particles of cartilage may become loose and give rise to further joint mice. It has been our experience that in time these bodies gradually enlarge in size. If the pedicle is of sufficient size to promote blood supply, this centre of bone may not necessarily be dead, as illustrated in the following sections, which show blood-vessels passing through the pedicle into the osteocartilaginous body. Later when this pedicle is torn, the bony growth ceases, but apparently cartilaginous growth continues until finally it surrounds, in most instances, the bone complete.

The condition is purely a surgical one, and when all loose bodies have been removed and the borders of the crater have been smoothed down so as to prevent particles of cartilage breaking loose, I believe that the result will always be good. However, in operating upon these patients, frequently several small particles of cartilage are found floating in the synovial fluid, and these, I believe, ultimately enlarge and may produce new bodies if not removed. The importance of the x-rays is to be emphasized.

In osteochondritis dissecans we have purely a surgical condition; one in which we get practically 100 per cent. results, and one in which the x-ray plays an important part in the diagnosis.

Dr. R. B. Osgood, Boston: I would like to ask Dr. Freiberg whether he believes these bodies increase in size in the joint, when they are entirely unattached from the synovial membrane. Fisher has suggested that they grow in size at periods by becoming attached and then becoming redetached. He assumes that growth occurs through the pedicle until they become entirely detached. These bodies have been supposed to grow when perfectly free. The sections suggest that. Considering the nourishment of cartilage to be, not from the blood supply, but from the synovial fluid, I wonder if Dr. Freiberg had any evidence to indicate that these bodies continue to grow in size when they are free in the joint.

Dr. A. H. Freiberg, Cincinnati (closing the discussion): I felt that my Case 4 was about as good evidence as we could get, even though I must acknowledge that there was a loop hole in the evidence; in other words, this young man came to me with this one body apparently well attached. He had had symptoms before he came. He came to me a year later with this dense body in a different place, four times as large as it was originally. When I removed it, only ten days after I saw it in the joint line, it was way up in the knee, and there was no sign of a pedicle, so that I felt that that was about as good evidence as we were likely to get that such bodies grow in size after they are definitely separated from the original site.

COMBINED CISTERN AND LUMBAR PUNCTURE: AN AID IN THE DIAGNOSIS OF COMPRESSION OF THE SPINAL CORD.*

BY JAMES B. AYER, M.D., BOSTON.

THE communication consisted of a demonstration on a manikin of the hydrodynamic relations within the spinal subarachnoid space, normally, and in conditions of block; together with an estimate of the significance of these findings and of certain chemical tests made on fluids obtained from cisterna magna and lumbar sac.

To the orthopaedist, almost as often as to the internist, neurologist or neurological surgeon, there comes a patient in whom the diagnosis of spinal cord tumor or cord compression from other source is a possibility. In such a case the evidence in favor of some form of degenerative myelitis and of cord tumor is weighed without definite conclusion. Any help to the clinical examination should here be most welcome, and is frequently to be found in a careful study of the spinal fluid, by the method here described.

Spinal fluid findings characteristic of—perhaps pathognomonic for—cord compression were first described by Froin[1] in 1903, and later verified by writers in many countries. Such a fluid is yellow in color, clots on standing, contains a massive amount of protein, and few or no cells; it is usually scanty in amount, and obtained under low pressure. Such a fluid is seldom found except below excessive or rapidly produced compression of the spinal cord. In 1910 Nonne[2] and in 1912 his pupil Raven[3] called attention to the fact that below cord tumors the fluid was more often clear and colorless, and without clot, but contained an excess of protein without pleocytosis. The recognition of this finding—isolated protein increase—became of great value in the corroboration of a diagnosis of probable tumor; but when tumor was thought unlikely, such a finding alone, in that it could not be considered in any sense pathognomonic, could hardly be relied upon.

To render the isolated protein reaction of Nonne of dependable significance in the diagnosis of cord tumor a certain dynamic test was brought forward by Queckenstedt[4] in 1916. This test, independently used by

*Presented at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

the writer, together with other tests designed to demonstrate blocking of the spinal subarachnoid pathways, supplements the chemical findings and renders a decision as to cord compression much more certain.[5, 6]

The method is briefly as follows:—two needles are placed in the subarachnoid space, one in the lumbar sac, the other in the cisterna magna; a glass manometer of 2 mm. bore is connected with each needle and spinal fluid allowed to flow into each. Certain observations are now made, of greatest significance being the relative change in fluid levels on (1) decrease of pressure, and (2) increase of pressure. The former is readily brought about by withdrawal of fluid, the latter by injection of saline solution, or, better still, because not requiring the introduction of a foreign substance, elevation of intracranial pressure by compression of both jugular veins in the neck. Normally, the fluid falls or rises promptly and equally in both manometers on artificially changing the pressure in either one of the above methods, thereby demonstrating continuity of the spinal subarachnoid space. Abnormally, in the cases under consideration, a rise of pressure at one point will cause no rise at the other; similarly, a drop in pressure will not be accompanied by a corresponding drop in the other. This result indicates spinal subarachnoid block.

It will readily be appreciated that many pathological processes may sever the continuity of the spinal subarachnoid space. The series studied includes demonstrable block in 34 patients, including numerous examples of tumors and abscesses exerting pressure from outside of the dura, of intramedullary tumors causing pressure from expansion outward, and of meningeal adhesions and tumors of the meninges narrowing the subarachnoid pathway. As the determination of block is no indication of the pathological process involved, neither is it evidence as to the localization of the lesion, for in this series block has been demonstrated alike at upper cervical and lower lumbar levels, and loci between.

While the demonstration of a block is the most reliable sign of the existence of some obstructing process, it is likely that transudation of protein about the lesion into the spinal fluid occurs even earlier. On examining fluids obtained from cases of cord compression, the fluid from the lumbar sac has always contained more protein than that from the cistern, frequently ten times, occasionally one hundred times as much.

It will be seen that by this method evidence of spinal subarachnoid block is two-fold: direct evidence of obstruction (hydrodynamic tests), and indirect evidence by chemical tests (hydrostasis). In a correct evaluation of these examinations it has been found that we have a reliable aid in diagnosis—at times earlier than apparently justified by

clinical examination alone—of the various pathologic conditions which cause compression of the spinal cord or constriction of its subarachnoid pathways.

(For a more complete exposition of the method and analysis of findings the reader is referred to two recently published articles.[5, 6])

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FRACTURE OF THE SPINE WITH CORD INVOLVEMENT.*

BY WILLIAM JASON MIXTER, M.D., F.A.C.S., BOSTON,

Assistant Visiting Surgeon, Massachusetts General Hospital.

THE surgery of fracture of the spine with cord involvement may be divided for convenience into two parts, the early and the remote. The early period, the first 24 hours perhaps, is of great importance, as it is during this time that damage to the cord, of a temporary character if relieved, may become permanent, if not so relieved. It is to the problems of this early period that I wish to call your attention.

In the first place let us for a moment analyze the procedures available in the treatment of fractures with cord involvement, and how we can apply them. The operation that immediately presents itself as a possibility is laminectomy. This operation has been criticized as weakening an already damaged spine and has been modified accordingly. Hemilaminectomy has been advocated, but in my hands has proven less satisfactory than complete laminectomy, as the exposure is limited. For the past few years I have used the following technique, fully realizing its limitations. The muscles of the back are dissected away from the spinous processes and laminae on one side only, care being taken to keep close to the bone and wherever possible to pick up periosteum with the muscle. This dissection is carried one vertebra above and one below those of which the arches are to be resected. Next, the spinous processes are cut away from the laminae with heavy forceps, leaving them attached to the muscles on the untouched side and connected to each other and to the spinous processes above and below by the interspinous ligaments. The dissection is then carried down along the laminae of the opposite side until the arches are completely exposed. This procedure is very similar to that advocated by Dr. Gaenslen[1] in a paper read before this Society in 1917, the salient feature being the preservation of the spinous processes and their ligamentous attachments, and I agree heartily with Dr. Gaenslen on the importance of saving these structures. The laminae are removed with rongeurs, all bone chips being preserved for future use. The various procedures indicated in a given case, such as removal of clot or indriven fragments of bone, reduction of deformity, longitudinal section of the cord and the like, are now carried out. The articulations, if not already destroyed, are

*Presented at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

now crushed and bone chips laid in between the stumps of the laminae on both sides with the idea of strengthening the damaged spine. The muscles are sutured to the interspinous ligaments, and the fascia and skin closed.

I have cut down a second time on one case treated in this way and was much pleased to find an almost continuous strip of bone on each side. The result, though not as strong as that of a fusion operation or a bone graft, must be stronger than that following the usual laminectomy.

Other operative measures which may be indicated are the fixation operations, either by bone graft or fusion, or more rarely by simply passing a wire or silk ligature about the spinous processes. The application of the fixation without laminectomy is more often indicated in the late case, but is occasionally of value soon after injury. Closed or open reduction of deformity without laminectomy is seldom indicated in the presence of cord lesion, except in fracture-dislocation of the cervical region. A discussion of the technique of fixation or reduction before this Society is out of place and so will be omitted. I think we can all agree that a carefully performed laminectomy, with proper effort to prevent a weakened spine, is the operation which will most frequently be performed.

I have summarized briefly as follows the pathological conditions which result from trauma, and the treatment I consider appropriate in each instance. With this summary as a starting point we can take up the individual lesions with an eye to the difficulties in diagnosis.

CHART 1.

Laminectomy.	Fixation Only.	No Operation.
Crush of the cord without loss of continuity.	Free fracture with slight cord involvement.	Severed cord.
		Crush of sufficient severity to prevent any recovery.
Intradural hemorrhage.	Fracture with increasing kyphos and slight cord involvement.	Hematomyelia.
Extradural hemorrhage.		Slight oedema or extravasation of blood.
Severe oedema.		
Deformity of the spinal canal causing angulation and compression.		
Severe injury to the cauda equina.		

The second group, those demanding fixation, is easily recognized and can be passed over with a word. To my mind such a case should receive adequate fixation, namely, a graft and plaster jacket. If there is a kyphos, an attempt may be made to reduce the deformity by traction before the graft is applied. If there is a free fracture, the problem is a little different and no definite form of fixation can be laid down. One case will be treated by a graft and the next will require suture of laminae or spinous processes.

The other two groups cannot be disposed of so easily, as the differentiation of the lesions enumerated is frequently difficult or impossible. If the fracture is below the cord and the cauda equina alone is involved, laminectomy is indicated unless the symptoms are slight and tend to subside rapidly. The time factor is less important here than in lesion of the cord itself and even in late cases marked improvement may be looked for from relief of pressure. For this reason it is wise to delay until examination reveals which roots have been permanently damaged. Motor roots if severed should be sutured, but the suture of sensory roots is useless.

Fractures with little deformity and slight injury to the cord, especially if there is subsidence of symptoms, require no operation, a plaster shell and recumbency being adequate treatment at first. Such a case probably represents a moderate amount of oedema of the cord with, possibly, some extravasation of blood. I have placed hematomyelia in the group of lesions in which operation is not indicated, but I must admit I have some misgivings in so doing. A clot within the substance of the cord is as much a foreign body as if present elsewhere and I should not be greatly surprised to find its evacuation advocated in the near future. Of course such a clot usually extends for several segments up and down the cord, making its evacuation a very serious problem. I consider the prognosis for complete recovery in untreated hematomyelia to be more than doubtful. Paralysis of the Brown-Séquard type is indicative of hematomyelia and is, if we accept the above, a contraindication to operation.

We can feel pretty sure of our ground for and against surgical intervention in the groups of cases so far enumerated, but unfortunately we have left a large group in which the diagnosis will be more doubtful, as each and all of them may present the same clinical picture. This group comprises on the one hand partial crush of the cord, many cases of extra-medullary hemorrhage, contusion, and severe oedema, all demanding surgical treatment; while on the other hand we have complete cord section, irreparable crush, many cases of hematomyelia and

a number of cases of mild contusion or oedema with grave initial symptoms, in all of which operation is useless. All the pathological conditions here enumerated may and frequently do present the symptoms of a complete lesion. We have all seen patients with abolished reflexes, complete motor and sensory paralysis, and so forth, go on to ultimate recovery.

The war has given us positive evidence reported by many observers that patients with complete cord section may develop, at a later date, marked reflex activity and complicated defense movements. The defense movements may be of such a character as to give rise to the erroneous belief that regeneration of the cord has taken place. While not applicable to the early case, this refutation of Bastian's Law,[2] accepted as a fact by the writers of fifteen years ago, shows the importance of recent progress in neurology. If, then, it is so difficult to differentiate between the severe and the mild types of injury, what are the indications for operation. Numerous writers, both in this country and abroad, have stated in very positive terms that the only cases suitable for operation are those in which the symptoms point to a partial lesion only and that operation should only be performed after a sufficient interval of time has elapsed to prove this partial lesion and that spontaneous recovery will not take place. To my mind this attitude, though conservative, must abandon, as hopeless, a certain number of cases in which operation would be of benefit.

Dr. A. R. Allen[3] in a classical piece of experimental work on animals found that, even if sufficiently bruised to cause permanent paralysis, the cord would recover if a median longitudinal section was performed within a few hours of the time of injury, thus permitting the escape of oedema from the cord. This work was most painstakingly carried out. He used a contrivance like a miniature pile-driver to give the blow to the cord and so could measure the impact in gram centimeters. An impact far greater than that required to cause permanent paralysis was given directly to the cord after laminectomy had been performed and then after a delay of two or more hours the cord was split, the wound closed, and the animal allowed to recover. The period of convalescence was long in some cases, but the fact of recovery of function was amply proved. Where longitudinal section of the cord was postponed for six hours even, there was more destruction of the tissue than in the animal whose cord was sectioned in two hours. To my mind, this work is of the greatest importance in the problem in hand. It gives us a direct means of reducing the pressure within the cord and

of draining serum, extravasated blood, etc., and also proves that delay is dangerous.

Frazier[4] gives much credit to Allen for his work. His conclusions are too long to be quoted here, but are most valuable reading for anyone interested in this subject. He states:

"There is a prevailing sentiment that a complete transverse lesion is in itself a positive contraindication of operation. To maintain this attitude one must assume that the symptoms of a complete transverse lesion invariably indicate an irreparable damage to the cord. Clinical experience, however, does not bear this out. I have come to disregard the clinical picture of a complete transverse lesion *per se* as a contraindication to operation." And later: "If operation is to be performed at all it should be done at the earliest possible moment."

My own rules are as follows: Consider every fractured spine with cord involvement a surgical emergency until it is satisfactorily demonstrated that operation is not indicated. Any case showing increasing symptoms should be operated on at once or as soon as the patient has sufficiently recovered from shock. If at first examination it cannot be determined whether or not the lesion is progressive, the findings are carefully noted, particularly the sensory changes, and shock treatment instituted. A few hours later the patient is again examined and a third time if necessary. If symptoms have increased, laminectomy is indicated. If they have decreased, it is contraindicated.

This will still leave a considerable group undecided, as most cases with complete paralysis from the beginning will show no change whatever. If from the history, local or x-ray examination, it seems certain that the lesion is a complete crush, operation is contraindicated. If a pure hematomyelia, the same is true. (I have yet to see a case in which I could feel at all sure of the diagnosis of hematomyelia within the first 24 hours.) If the cord damage is slight enough to make it probable that regression of symptoms will take place, operation is contraindicated. I fully realize that this last statement is vague and unscientific and leaves much to be desired, but it is as near as I can come to anything exact. If the signs of complete section are present but not borne out by history, local examination, or x-ray, laminectomy should be performed in the hope of finding some remediable lesion, though the chances of improvement are slight. If there is evidence at this time of marked angulation or any other cause of direct compression and yet not enough to warrant a diagnosis of complete transsection, operation is indicated. If there is evidence of damage to the cord, other than complete section sufficient to cause total disability, should it persist, operation is indi-

cated. Lesions of the cauda equina may be left for some time before operation is finally decided upon, but where the cord itself is damaged, a definite course should be mapped out within the first 24 hours. As Allen has shown, operation after that time has passed is of much less value and I consider late operation to be justified only in unusual circumstances.

CHART 2.

	Total.	Improved.	Unimproved.	Died in Hospital.
Laminectomy	16	4	6	6
Transsection	2			
Crush or oedema	11			
Hemorrhage	2			
No lesion found	1			
Fixation only (no operation)	3	3	0	0
Slight cord involvement (no operation)	25	22	3	0
Apparent transsection	9	2	3	4
Total	53	31	12	10

Note:—In 4 cases of this series a longitudinal incision was made in the cord, but in only one was there any improvement. I think it is fair to add that in all the 4 cases the cord was very severely damaged—much more severely than in those cases in which cordotomy was omitted.

Following this scheme at least four definite errors are shown in my group of cases; two at operation showed complete section and two in which operation was not advised, on the ground that complete section existed, ultimately showed definite though incomplete restoration to function. (Thus emphasizing the point that clinical evidence of a complete section may be deceptive.) Of the sixteen laminectomies only four showed relief of symptoms and in all of these the critic can say "Would these patients not have done as well without operation?" In one, he probably would be right (no lesion found); in the other three, in my opinion, operation was of value, though there is no definite proof.

There is no doubt that the results of surgery of trauma of the cord can be improved in several ways. First, by improvement in our operative procedure. We need a wide laminectomy combined with easy, rapid, and immediate fixation. In such critical cases the extra time and manipulation required for a tibial graft is almost invariably out of the question. Perhaps fixation with beef bone can be utilized. Second, speed in all the preliminaries, immediate neurological examination, x-ray examination, institution of shock treatment, and then a review of the neurological findings to demonstrate any changes. All this to be

done within the first few hours. Third, a more careful routine examination of the cerebro-spinal fluid by lumbar puncture or by combined puncture of the lumbar space and the cisterna magna. This examination should include in every instance pressure readings, evidence of block, presence of proteid or of blood. A series of such examinations with the subsequent findings in each case might give us data that would go far toward solving our problem. Lastly, the war has provided a wealth of neurological material which is only now beginning to be available. Methods of neurological examination and interpretation of results are improving and we must see to it that our neurological consultants apply these improvements.

I have tried in this paper to limit myself to the general consideration of this subject and have omitted almost all mention of special conditions and already solved problems, and have devoted my attention to what may be called the doubtful case.

To my mind the time is already past and gone when a surgeon has reason to say: "You must simply make up your mind to operate on all or none." We can pick our cases and we can do it with some degree of success. Closer attention to detail and a further striving for new light on our part will eventually dissipate, to a considerable extent, the shadow which hangs over the man with a broken back.

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CRUSH FRACTURES OF THE SPINE.*

JAMES O. WALLACE, M.D., PITTSBURGH, PA.

THE object of this communication is to present to you a study of 82 cases of fracture of the spinal column, of which a great majority had been unrecognized and consequently untreated, causing a great deal of unnecessary pain and disability as well as a great economic loss to the community.

The spinal column is a flexible tube whose outline varies with every movement of the body. It supports the head and trunk, and maintains the body in an erect posture. The spine has an anterior support, the vertebral bodies and intervertebral discs, and a posterior support, the articulations. Of these, the posterior supports are the most important, for a lamina may be removed and the vertebral body crushed, and yet one may stand erect.

Fracture of the spine results from direct violence and indirect violence. The most frequent cause is indirect violence, in which there is a hyperflexion, a hyperextension, or a shortening of the longitudinal axis of the column beyond the limits of its elasticity.

Fractures in which hyperflexion or hyperextension are the agents are more common in regions where a more fixed portion of the spine meets a movable portion, as in the dorso-lumbar or dorso-cervical portion.

Fractures in which shortening of the longitudinal axis takes place are in the fixed regions and are usually the result of indirect action; the articulating processes are first crushed.

In indirect fracture of the spine—there is generally crushing of the bodies, rupture or sprain of the posterior ligaments and muscles, rupture or sprain of the anterior ligaments, dislocation and rotation of the vertebrae.

TYPE OF INJURY IN 82 CASES.

In six cases the method of injury was not given, leaving 76 cases.

In nine cases the history of the injury gave no definite forcible flexion of the spine and the mechanism of the fracture could not be determined.

This leaves 67 cases in which a definite history of forcible flexion of the spine was given. These cases can be divided into three different

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

PLATE No. 1.—Showing side view of spine with deformity as taken in the ordinary way.

types according to the manner in which the forcible flexion was accomplished.

Type I.—In which some heavy object fell from above, alighting on the patient. Most of these cases were falls of slate or roof coal in the mine, and generally struck the patient when the spine was already slightly flexed from his position in working. In most cases the patient told of being doubled up and in quite a few cases stated that "his head was forced between his legs."

Type II.—In which the patient fell from a height, striking the ground on head and shoulders. Among these cases were falls from trestle, tipple, scaffold, buildings, house, wagon, elevator shaft, and in diving and striking head on bottom or projecting shelves.

Type III.—In which patient was squeezed between two objects, causing slow forcible flexion of the spine; as a farmer driving a load of hay into a barn was squeezed by jamb of door and hay.

Notenda.—In one case the patient gave a history of lifting a mine car back on the track, which he accomplished and says he "felt something give in my back."

PLATE No. 2.—Showing side view of the spine with the legs flexed on the abdomen to hold the lumbar spine straight, thus throwing the deformity in the upper fragment. This is the proper way to take an x-ray picture in order to determine how much deformity really exists in a spine.

Of 67 cases of forcible flexion:—

Type I	45 cases
Type II	17 cases
Type III	5 cases

In every case in which the history showed a patient was caught in a flexed position and had spine flexed so that head was forced between legs, a fracture of one of the lower vertebrae was found.

AGE, SEX, AND OCCUPATION.

Age.—Out of 82 cases, the age was not given in 18 cases, leaving 64 cases. Youngest case was 16 years. Oldest case was 65 years. Average age was 39 years. Below 40 years there were 35 cases. Above 40 years there were 29 cases.

PLATE No. 3.—Showing side view of the spine with the dorsal spine held straight, thus throwing all the deformity in the lower fragment or lumbar spine. This is the position in which the patient is placed on the frame for application of a body cast.

Age by decades:

Below 20 years	4
20 to 30 years	14
30 to 40 years	17
40 to 50 years	12
50 to 60 years	11
Over 60 years	6

Sex.—Most of the cases represent industrial casualties and naturally are nearly all males. The few cases of females represent the percentage of ordinary accidents seen in private practice.

82 cases below show male 78—female 4.

Occupation.—In 12 cases the occupation was not given and in five cases the patient had no occupation, leaving 65 cases.

Most of our cases are coal miners, an industry in which forcible flexion of the spine from falls of slate, roof coal, etc., is a very common occurrence.

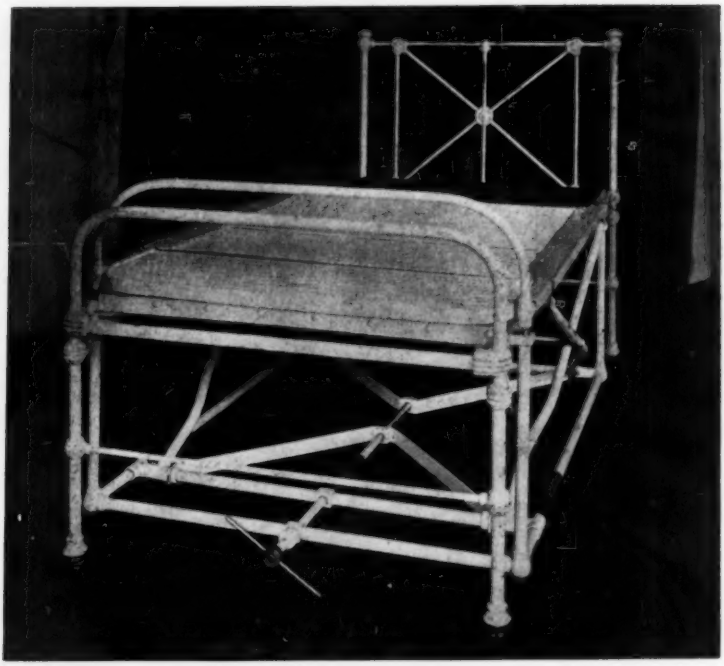

PLATE No. 4.—Showing a new frame on bed with screw in end by which it is elevated. Shows corrugated top in two pieces, the one sliding over the other to accommodate different sizes of patients and different sites of deformity. In this position, it can be used as a fracture board. Note the cradle on end of frame, to which the feet are tied.

In 65 cases, 46, or 71%, were coal miners.

Among others were laborers, structural iron worker, railroad brakeman, carpenter, baker, clay miner, painter, driver, coke worker, moulder, elevator girl, rigger, farmer, farm superintendent, and platform man for express company.

Previous Diagnosis and Elapsed Time When Seen by Us.—In 8 cases, the question of previous diagnosis was not given. In 7 cases, charge was assumed immediately. This leaves 67 cases. Diagnosis not made previously—47 cases. Diagnosis made previously—20 cases.

It is interesting to note that in 20 cases in which a diagnosis of fracture of the spine had been made previously, 15 cases, or 75%, had paralysis. In the 47 cases in which no previous diagnosis had been made, only 3 cases, or 6%, had any paralysis, and two of these consisted merely of weakness of isolated muscles.

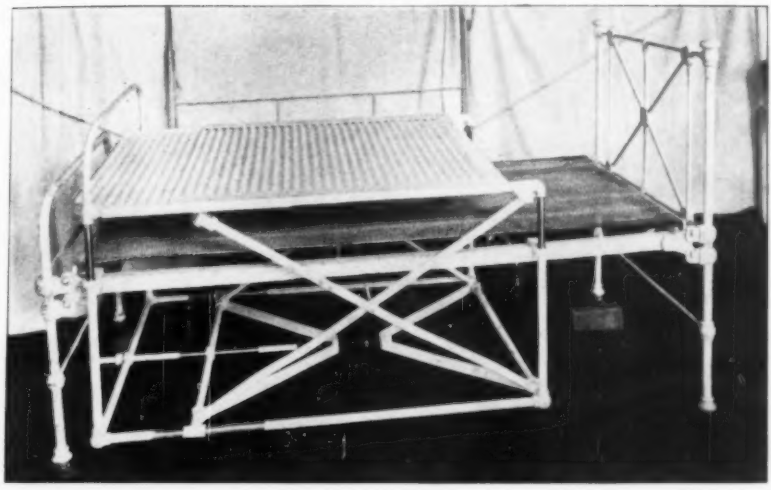

PLATE No. 5.—Showing the frame raised about seven inches.

In 10 cases elapsed time was not given. In 7 cases charge was assumed immediately. This leaves 67 cases. Averaged elapsed time 373 days.

In the 47 undiagnosed cases, the shortest time elapsed since injury was 25 days and the longest period of elapsed time was 1045 days. Averaged elapsed time 311 days.

ASSOCIATION WITH OTHER INJURIES OUTSIDE OF SPINE.

In four cases not given in record. This leaves 78 cases. No injuries outside of spine — 55 cases. Injuries outside of spine — 23 cases.

Analysis of Other Injuries:

Fracture of Ribs	11 cases
Fracture of Tibia and Fibula	6 cases
Fracture of Femur	3 cases
Fracture of Skull	2 cases
Fracture of Clavicle	2 cases
Fracture of Humerus	2 cases
Fracture of Pelvis	1 case
Fracture of Acetabulum	1 case
Fracture of Radius and Ulna	1 case
Fracture of Tarsals and Metatarsals	1 case

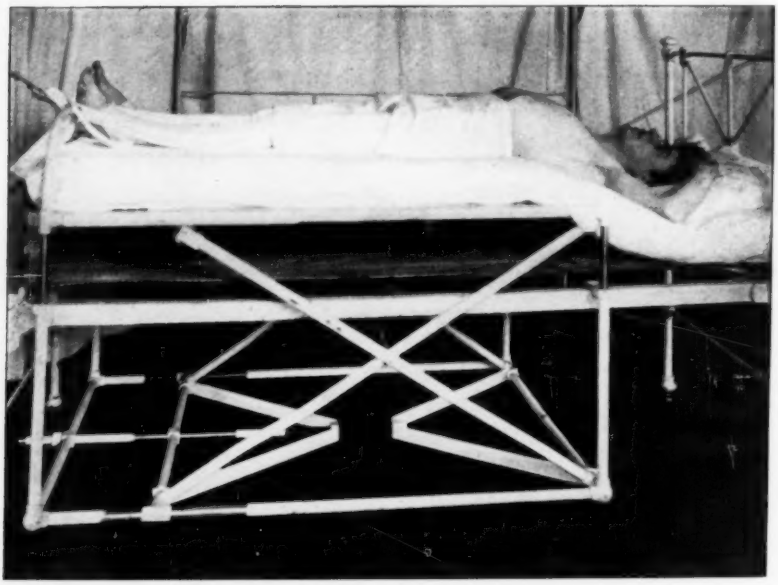

PLATE No. 6.—Showing the frame in use. Note the patient tied to the frame with glued stockinette. Notice the lower fragment parallel and the upper fragment hyperextended. Notice also the position of the chest, the wide costal angle and the abdominal viscera up in proper position.

Dislocation of Shoulder	1 case
Dislocation of Internal Semilunar	1 case
Rupture of Crucial Ligament of Knee-joint	1 case

Notenda:—Two cases are worthy of special note—*viz:* in one of which the patient sustained a fracture of the first rib on both sides (2nd dorsal vertebra crushed) and one who had a dislocation of the internal semilunar cartilage, left knee, which had been the chief disability from the patient's standpoint ever since injury (1st lumbar vertebra crushed).

ASSOCIATION WITH OTHER INJURIES OF THE SPINE.

In one case no x-ray was obtainable. This leaves 81 cases. Fracture of the transverse processes was the most common injury. This occurred on either one or both sides and of the vertebra crushed; sometimes the vertebra above and below. Fracture of the spinous processes was rather rare, having occurred in only three of our cases. Fracture of the articular processes occurred in one case. Total 81 cases:

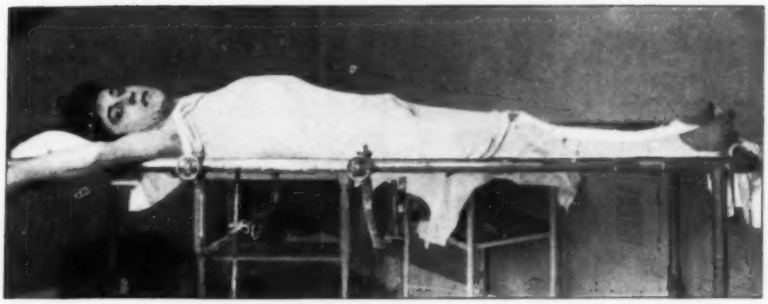

PLATE No. 7.—Showing the patient in proper position on the frame for the application of a new type of body cast. Note that the dorsal spine representing the upper fragment is in a perfect horizontal position, while the lumbar spine representing the lower fragment is allowed to arch forward.

Fracture Transverse Processes.....18 cases
Fracture Spinous Processes..... 3 cases
Fracture Articular Processes..... 1 case

COMPLAINTS OF PATIENTS.

Pain.—No data on 22 cases, leaving 60 cases for statistics. In half the cases the patients not only had pain in the back, but also had pain referred to other parts, generally the legs, also to hips, chest, abdomen, head, etc. In a few cases they had no pain in back, but had referred pain. In a few cases they had no pain whatever.

Pain in back, also referred pain.....30 cases out of 60, or 50%
Pain in back alone.....20 cases out of 60, or 33 1-3%
Referred pain only..... 4 cases out of 60, or 6 2-3%
No pain at all..... 6 cases out of 60, or 10%

Pain in back — 50 cases out of 60 — 83 1-3%
No pain in back — 10 cases out of 60 — 16 2-3%

Other Complaints of Patients:

1. Paralysis or weakness of legs in all cases with paralysis — 23 cases.
2. Loss of bowel or bladder control when present — 8 cases.
3. Sensory disturbance — 4 cases.
4. Weak back — 16 cases.
5. Stiff back — 13 cases.

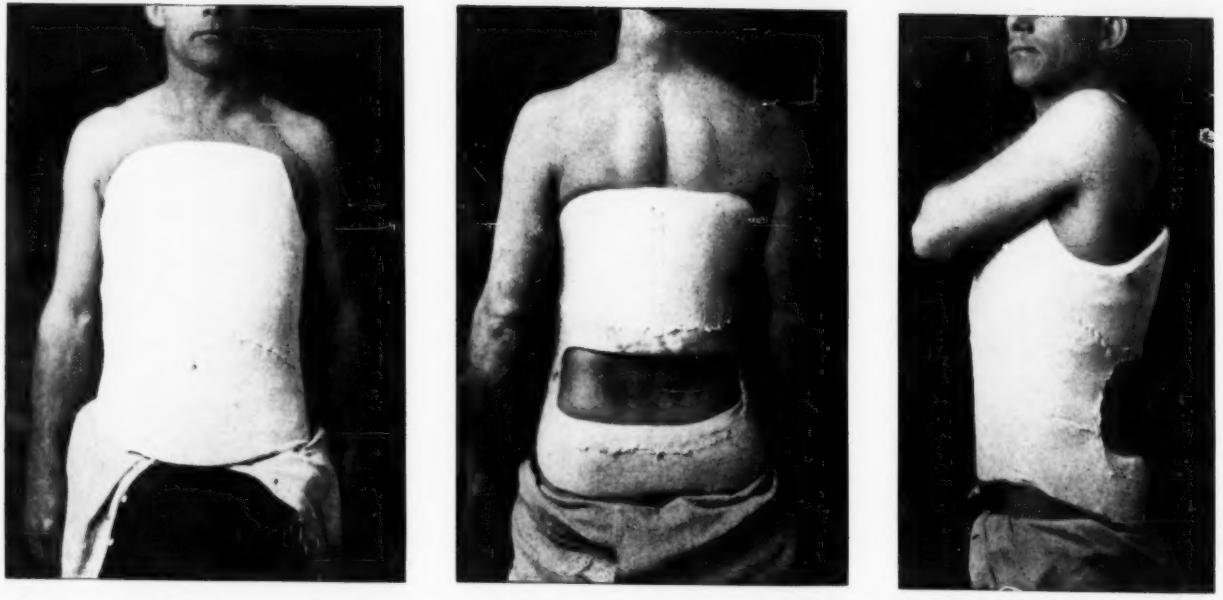

PLATE No. 8.—Photograph showing new type of body cast with the window cut out in the back just below the point at which the spine deforms. During application of the cast, the spine was held with the dorsal spine horizontal and allowing the lumbar spine to arch forward. The position of the spine as shown in Print No. 3, lateral x-ray view of the spine. The position on the frame for application of the cast is shown in Print No. 7.

PLATE No. 9.—Showing an old fracture crush before treatment. Notice the prominent spines and the flexion deformity.

6. Cannot straighten back — 8 cases.
7. Cannot lift — 6 cases.
8. Shortness of breath — 3 cases.
9. Loss of sexual power — 2 cases.
10. Nervousness — 3 cases.

DEFORMITY.

No data on 24 cases. This leaves 58 cases for statistics.

In all the cases but 2 (fracture of the 5th lumbar vertebra), the spinous processes were prominent, making localization of fracture possible before radiography. The two fractures of the 5th lumbar vertebra had an increased lumbar lordosis.

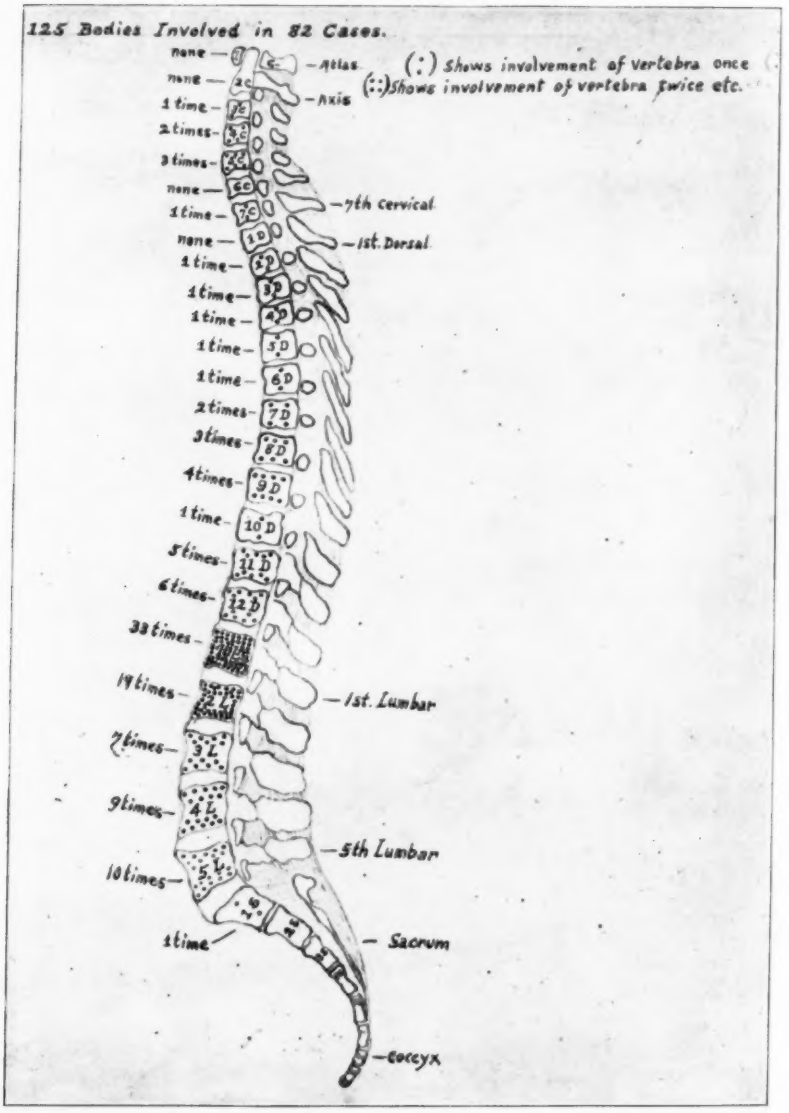
125 Bodies Involved in 82 Cases.
(:) Shows involvement of vertebra once
(::) Shows involvement of vertebra twice etc.
none — 1C — Atlas
none — 2C — Axis
1 time — 3C
2 times — 4C
3 times — 5C
none — 6C
1 time — 7C — 7th cervical
none — 1D — 1st. Dorsal
1 time — 2D
1 time — 3D
1 time — 4D
1 time — 5D
1 time — 6D
2 times — 7D
3 times — 8D
4 times — 9D
1 time — 10D
5 times — 11D
6 times — 12D
33 times — 1L — 1st. Lumbar
19 times — 2L
7 times — 3L
9 times — 4L
10 times — 5L — 5th Lumbar
1 time — Sacrum
Coccyx

PLATE No. 10.—Fracture crush of vertebral bodies (82 cases). Diagram showing the relative frequency of fracture involving the various individual vertebrae.

PLATE No. 11.—55. Mr. V. W. Age 50 years. Diving, struck head on stone shelf. Paralyzed from neck down. Fracture on the anterior upper quarter of 7th cervical vertebra with 6th cervical vertebra forward and posterior edge of 6th cervical fitting in step on 7th cervical.

In 12 cases, no deformity was present, but the spinous processes of the fractured vertebra were prominent.

In some cases, a kyphosis was present alone; in some a scoliosis, and in others they were combined. In two cases, a rotation deformity alone occurred.

Deformity present in 46 cases out of 58 cases — 79%.

Kyphosis	28 cases
Scoliosis	20 cases
Rotation	2 cases
Lordosis	2 cases
Flexion Cervical Spine	4 cases

Posture.—In some cases the fracture was grafted on a poor posture.

Notes on Posture:—

Round shoulders, visceroptosis, hollow back	6 cases
Round shoulders, visceroptosis, flat back	3 cases
Round shoulders alone	2 cases
Hollow back alone	2 cases
Flat back alone	6 cases

PLATE No. 12.—62. Mr. J. W. Age 32. Platform Expressman. 150 lb. box fell off wagon on head and shoulders. No paralysis. Shows moderate crush of 4th and 5th cervical.

DISLOCATION OF VERTEBRAL BODY.

1. Lateral Dislocation.—In 25 cases out of 81 lateral dislocation present — 31%.

2. Anterior Dislocation.—In 5 cases out of 81 anterior dislocation present — 6%.

3. Posterior Dislocation.—In 4 cases out of 81 posterior dislocation present — 5%.

In 2 cases paralysis both legs.
In 1 case (78) no data on paralysis.
In 1 case no paralysis present.

LIMITATION OF MOTION.

No data on 24 cases. This leaves 58 cases for statistics.

In all the cases there was some limitation of motion present. In no case was a note made that no limitation of motion was present, but in 6 cases out of 58 there was only slight limitation.

In nearly all the cases extension of the spine was the motion most

PLATE No. 13.—81. Mr. D. M. Age 24. Walked off a trestle in dark 30 or 40 feet high. Was in two different hospitals for observation. No diagnosis made. Came in complaining that he couldn't get his breath and had pain in back. X-ray shows a crush of the 9th and 10th Dorsal. Antero-posterior view shows a lateral dislocation of the 10th Dorsal vertebra to left on 9th.

restricted. In a vast majority of cases, normal hyperextension of the spine was impossible either actively or passively. Lateral bending was also restricted in most cases. In most cases forward bending was freer than other movements and in all cases, except those with a marked lumbar lordosis, forward bending was not restricted to any marked degree.

Muscle Spasm.—Except in early cases, which are in the minority in this series, muscle spasm was usually not present, and when present, was only slight.

No data on most cases. Recorded as present in 22 cases. Recorded as slight in 4 cases. Recorded as absent in 10 cases.

Hamstring Spasm.—No data on most cases. Recorded as present in 13 cases. Recorded as absent in 8 cases.

TENDERNESS ON PRESSURE.

Grasping the spinous process of the fractured vertebra between the fingers and exerting deep pressure produced a deep bone tenderness

PLATE No. 14.—49. Mr. J. P. Age 49. Moulder. Eighteen ton casting fell on him, crushing him down into moulding sand, burying him. Fracture of right femur. Back unrecognized. Moderate crush of 2nd lumbar and slight crush of last two Dorsal and 1st and 2nd Lumbar. Bone Bridge anteriorly between 1st and 2nd lumbar. X-ray taken after treatment.

comparable to the tenderness of callus, while still soft, in the healing fractures of long bones, or is due to pull of ruptured or strained ligamentous attachments on the spinous process. This was found present in all early cases and in most late cases. It seems to leave under treatment as the repair occurred in the crushed vertebrae.

No data given on 50 cases. Marked present in 28 cases. Marked absent in 4 cases.

Notenda:—In four patients having no tenderness, three of them were of 1 to 2 years' standing before examination, and the other had a fracture of the 5th lumbar, with the symptoms all referred to the left leg.

PARALYSIS.

No data on paralysis on 4 cases. This leaves 78 cases.
Paralysis present in 23 cases. No paralysis present in 55 cases.
Paralysis present in 23 cases out of 78, or 30%.

PLATE No. 15.—39. Mr. E. W. Age 60. Coal Miner. Fall of slate. Hour glass contraction of 2nd Lumbar, the first Lumbar being the causative factor. Shows a very severe flexion must have taken place in order to produce such a deformity.

Extent of Paralysis.—1.—Both legs, 13. 2.—One leg, right, 4; left, 5; total 9. 3.—Both arms and both legs, 1.

Anesthesia noted present in 9 cases.

Bowel and Bladder disturbances noted present in 8 cases.

Reflexes: Noted increased in 20 cases. Noted decreased or absent in 9 cases.

Effect of Age on Paralysis: Number of cases where age and paralysis were given — 15 cases.

Age under 40 years — 8 cases
Age over 40 years — 7 cases

By Decades: —

Under 20 years.....0 cases
20 to 30 years.....5 cases
30 to 40 years.....3 cases
40 to 50 years.....2 cases
50 to 60 years.....5 cases
Over 60 years.....0 cases

Apparently no influence in any of the above cases.

PLATE No. 16.—27. Mr. J. L. Aged 30 years. Mine Foreman. Fall of slate; untreated. Seen 87 days after accident. Had flexion deformity of 45 degrees with a right dorsal left lumbar scoliosis. Side view shows the wedging of the first Lumbar and healing between the antero superior surface of the 1st Lumbar and the inferior surface of the 12th Dorsal. This man was corrected. The correction was of posture and not at the site of fracture which was firmly united when seen.

Effect of Type of Injury on Paralysis.—In 67 cases of Types I, II, and III, there were 20 cases of paralysis, or 30%.

Type I.—14 cases out of 45 cases, 31%. No influence. Type II.—5 cases out of 17 cases, 29%. No influence. Type III.—1 case out of 5 cases, 20%. No influence.

Effect of Vertebra Involved on Paralysis.—In 23 cases out of 81 cases, paralysis occurred.

1st Lumbar—10 cases paralyzed out of 33 cases where 1st lumbar involved—30%.

2nd Lumbar—4 cases paralyzed out of 19 cases where 2nd lumbar involved—21%.

4th Lumbar—4 cases paralyzed out of 9 cases where 4th lumbar involved—44%.

3rd Lumbar—2 cases paralyzed out of 7 cases where 3rd lumbar involved—29%.

PLATE No. 17.—28. Mr. I. L. Aged 53. Fracture Crush 5th Lumbar. Dislocation of 4th on 5th to left. Fracture of the left ala of sacrum. Fracture of the transverse processes of the 4th and 3rd Lumbar; both sides.

5th Lumbar—1 case paralyzed out of 10 cases where 5th lumbar involved—10%.

7th Cervical—1 case paralyzed out of 1 case where 7th cervical involved —100%.

4th Cervical—1 case paralyzed out of 2 cases where 4th cervical involved—50%.

9th Dorsal—1 case paralyzed out of 4 cases where 9th dorsal involved —25%.

11th Dorsal—1 case paralyzed out of 5 cases where 11th dorsal involved —20%.

Location of Fracture.—Based on 81 cases. In majority of cases, a single vertebra was involved. Single body crushed, 60 cases. More than one body crushed, 21 cases. The only individual vertebrae not involved in this series were the 1st and 2nd cervical, 6th cervical, and 1st dorsal vertebrae. In one case, the 1st sacral segment had been crushed.

Following is the involvement of the individual vertebrae in order of frequency; 125 vertebrae crushed in 81 cases.

PLATE No. 18.—73. Mr. G. K. Driving a hay wagon, caught between the top of the door and the hay. Two wedge-shaped vertebrae. Pressure equally applied above and below. Example of Type 3.

1 Lumbar	33 times	41%
2 Lumbar	19 times	23%
5 Lumbar	10 times	12%
4 Lumbar	9 times	11%
3 Lumbar	7 times	9%
12 Dorsal	6 times	7%
11 Dorsal	5 times	5%
9 Dorsal	4 times	5%
8 Dorsal	3 times	4%
5 Cervical	3 times	4%
7 Dorsal	2 times	2%
4 Cervical	2 times	2%
3 Cervical	1 time	1%
7 Cervical	1 time	1%
2 Dorsal	1 time	1%
3 Dorsal	1 time	1%
4 Dorsal	1 time	1%
5 Dorsal	1 time	1%
6 Dorsal	1 time	1%
10 Dorsal	1 time	1%
1 Sacral	1 time	1%

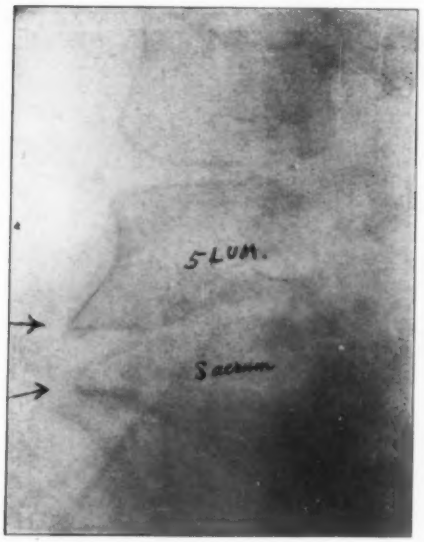

PLATE No. 19.—66. Mr. John A. Miner. Age 39. Lifting a coal car on a track, foot slipped and lifting it again felt something give in his back, causing him to fall to the ground. X-ray shows a crushing of the anterior inferior surface of 5th Lumbar; anterior superior surface of sacrum, with marked spur formation.

12th Dorsal,—1st and 2nd lumbar involved in 48 cases out of 81 cases, or 59%. Lumbar vertebrae crushed 78 times out of 125 times, or 62%. Last 7 vertebrae (11th and 12th Dorsal and Lumbar) crushed 89 times out of 125 times, or 71%.

Effect of Age on Location of Fracture.—Under 40 years of age—1st Lumbar involved 18 times in 34 cases, or 53%. 12th Dorsal—1st or 2nd Lumbar involved in 22 cases out of 34, or 65%. Over 40 years of age—1st Lumbar involved 7 times in 29 cases, or 24%. 12th Dorsal—1st or 2nd Lumbar involved in 10 cases out of 29, or 34%.

By Decades: Under 20 Years.—Total cases. 1st L. involved 2, or 50%. 12th D.—1st L. 2nd L. 3, or 75%.

20-30 Years.—Total cases 13. 1st L. involved 7, or 54%. 12th D.—1st L. 2nd L. 10, or 77%.

30-40 Years.—Total cases 17. 1st L. involved 9, or 53%. 12th D.—1st L. 2nd L. 9, or 53%.

40-50 Years.—Total cases 12. 1st L. involved 4, or 33 1-3%. 12th D.—1st L. 2nd L. 6, or 50%.

PLATE No. 20.—24. Mr. L. Z. Coal Miner. Fall of slate; paralysis of left leg. Had laminectomy done. Complains of weak back and paralysis of left leg. Crush of 1st Lumbar by 2nd Lumbar. Right articulating surface of 12th Dorsal vertebra crushed off. Dislocation of 2nd Lumbar to right on 1st. Shows lateral bone bridges between 1st and 2nd Lumbar on both sides, and dense healing.

50-60 Years.—Total cases 11. 1st L. involved 3, or 27%. 12th D.—1st L. 2nd L. 3, or 27%.

Over 60 Years.—Total cases 6. 1st L. involved 0, or 0%. 12th D.—1st L. 2nd L. 1, or 17 %.

1st Lumbar Involved.—Type I, 16 in 45, or 36%. Type II, 7 in 17, or 41%. Type III, 3 in 5, or 60%.

12th D.—1st L. 2nd L. Involved.—Type 1, 25 in 45, or 56%. Type II, 9 in 17, or 53 %. Type III, 3 in 5, or 60%.

PREVIOUS TREATMENT.

No data on 12 cases. Seen in consultation 1 case. Under care immediately — 5 cases.

This leaves 64 cases for statistics. Received previous treatment of back—18 cases. Received *no* previous treatment of back—46 cases.

PLATE No. 21.—37. Mr. John H. Aged 22. Coal Miner. Fall of slate; paralysis of both legs five weeks. Antero posterior view shows rotational deformity with dislocation of 4th Lumbar to left and crushing of 4th Lumbar on right side.

Other treatment received—Laparotomy, 1 case. Laminectomy, 4 cases.

Treatment with appliances (cast or brace), 8 cases.

CAUSATIVE FACTOR.

In studying the x-ray plates it was seen that while in most cases the vertebra above was the implement by which the force was applied to the vertebra crushed, in 20% of the cases the force seemed applied from below upward by the vertebra below.

BONE BRIDGE IN HEALING.

The presence of bone bridges extending from one vertebra to another were noticed in the healing process. Sometimes the bridge was anterior, sometimes lateral, and sometimes they formed both anteriorly and laterally. In most cases the bone bridge was growing from the vertebra crushed to the one which appeared to be the causative factor in the

PLATE No. 22.—57. Mr. G. F. Aged 57. Laborer. Fell twelve feet from porch roof, lit on shoulders, head between legs. Angular deformity. Crush of 11th Dorsal, more on the right side laterally. Dislocation of the 11th Dorsal to the left on the 10th Dorsal, showing dense healing and lateral bone bridges.

crushing. In 6 cases (23)—(25)—(38)—(57)—(60)—(64), the bone bridge had grown from the vertebra above the fractured one to the vertebra below the one fractured right across the crushed vertebra.

Cases showing bone bridge, 27 cases — 33%. Cases not showing bone bridge, 54 cases — 67%.

Variety of Bridge Shown.—Anterior bone bridge, 17 cases. Lateral bone bridge, 14 cases. Bone bridge across crushed body, 6 cases.

TREATMENT, DIVIDED INTO EARLY AND LATE.

Mechanics of Treatment.—In examining a fractured spine—especially the late cases, in lateral bending—you will find a point at which the upper fragment and lower fragment pivots. This pivot is at the site of the fracture, and will be at a point around the most prominent spinous process. This can be readily seen in a series of three lateral views of a case of tuberculosis of the spine.

PLATE No. 23.—36. Mr. R. M. Coal Miner. Fall of slate, producing a flexion of the spine. Triangular crush of the 1st Lumbar with posterior dislocation of the 1st Lumbar. Paralysis of bowels and bladder which is still present. Paralysis of both legs, which has cleared up.

Plate No. 1.—Showing the kyphosis with the deformity equally distributed above and below the kyphosis.

Plate No. 2.—Showing a flat lumbar spine with deformity thrown into the dorsal region above the kyphosis.

Plate No. 3.—Showing the straight dorsal spine with the deformity thrown into the lumbar region below the kyphosis.

We see in this series that most of the cases have been deformed by flexion of one portion of the spine on the other, so the idea of treatment has been to hold one fragment in the correct position and make the other fragments straighten out in the reverse steps that it took in producing the deformity.

We fix the lumbar spine, that is our lower fragment (which includes the spine from the site of the fracture down to the feet), by fastening the feet to the bottom of the frame. The lower fragment is held in a horizontal position, and by elevating this lower fragment, the upper fragment drops backward and downward. We thus get extension and counter extension.

We do this by means of a new frame which is hung on the side bar of the bed. The frame consists of a corrugated metal top in two parts,

PLATE No. 24.—38. Mr. P. B. Aged 35 years. Coal Miner. Fall of slate; crush of 12th Dorsal. Case seen immediately. Side view taken one year after return to work shows an anterior bone bridge connecting the 11th Dorsal and 1st Lumbar. This is an ideal result. This man, a coal miner, was back to work in 6 months, and has worked every day since returning to work that the mine has been worked.

which rests on top of the springs. This top is elevated by oblique arms and controlled by a screw situated at the end of the bed. As the screw is turned, the base is shortened, which also shortens the top, raising the frame. The range of the frame is eleven inches.

The principle of the treatment differs from the treatment on the Bradford frame in that we hold the lumbar spine straight, relaxing the flexors of the pelvis and do not get a lordosis when we hyperextend the upper fragment, but unfold the deformity.

Plate No. 4.—Shows an end view of frame with top of frame on springs, in which position it can be used as a fracture board.

Plate No. 5.—Shows the frame raised about 8 inches from the bed.

Plate No. 6.—Shows a patient under treatment. Notice the feet fixed to foot of frame with the lower fragment level, and the upper fragment hyper-extended. Also notice the position of the chest, the wide costal angle and the digestive organs up in proper position.

After the patient has been corrected as much as it is deemed necessary, then our problem is to hold the spine until healing has taken place, not only of the bone, but also of the soft structures. The ordinary type of

PLATE No. 25.—7. Mr. H. S. Aged 38 years. Coal Miner. Caught by guy rope and thrown into a pit. Deep brush burn of left shoulder. Was in bed for two weeks for a brush burn. Nothing done for back. Fracture crush of 1st Lumbar and slight crush of 2nd Lumbar. Side view, showing entire regeneration of bone with anterior bone bridge; also an Albee bone graft in position, and a fracture of the graft which was sustained about a year afterwards in lifting a lump of coal; since graft was fractured, back has been much more movable.

cast with window cut out in front, or with towel put in for room for digestive purposes, did not work out in our cases. The patient deformed in the cast, so my associate, Dr. W. O. Markell, studying Plates Nos. 1, 2, and 3, whereby he could throw the deformity from the lumbar to the dorsal region and vice versa, worked out a new cast.

The patient is put on a horizontal frame shown in picture, No. 7, and the dorsal deformity is corrected by putting the upper fragment in a horizontal plane, thus throwing the deformity into the lumbar region, producing a lordosis. A pad of very thick, solid saddler's felt is sewed to the stockinette with its base at the most prominent spinous process, and an upright of the frame presses against the middle of this pad. Then the cast is applied, and is cut out in the back, the upper portion of the window being at the base of the pad. With this cast, he has three points of support, one in the back at the kyphosis, and two in front, high and low.

PLATE No. 26.—53. Miss I. C. Aged 18. Was swinging on a grape vine swing; fell ten feet; lit on feet, then doubled up and fainted. Severe pain in back; bed one week. Was unable to straighten spine for two weeks and then pain ceased, but she noticed a protrusion of her spine. Back hurting and pain increasing. Crush 1st Lumbar caused by 12th Dorsal. Plate shows healing between the vertebrae with a bone growing from the crushed vertebra upwards to the vertebra above. Example of internal healing.

In the erect position, the force of gravity, the abdominal expansion occurring during respiration and digestion—all tend to push the movable lumbar spine backwards. In other words, the more or less fixed dorsal segment is held straight and the movable lumbar spine is pushed back into a straight line. From time to time, a new pad is inserted under the old one as correction takes place.

Dr. Markell has a cast by which he not only prevents deformity, but can correct deformity; Plate 8 shows three views of the cast.

In older cases, the same procedure is carried out.

What do we accomplish by treatment?

In the early cases, we correct deformity and hold the patient in a correct position until healing has taken place, and this healing consists not only in repair and deposition of lime salts and the formation of bridges of bone, anteriorly, laterally, and internally, *but* in repair and shortening of the posterior group of muscles and ligaments, the anterior group of muscles and ligaments, and the lateral group of muscles and ligaments.

PLATE No. 27.—69. Mr. W. M. Aged 38. Coal Miner. Fall of slate; paralysis of both legs, bowels and bladder. Paralysis of bowels and bladder cleared up in eight months' time. Paralysis of legs—muscle power returning now, an equinus deformity with the anterior flexors of the feet weak but all present. He had a crush between the 1st and 2nd and 3rd and 4th Lumbar, the 4th Lumbar being crushed wedge shaped. This view shows lateral healing and very dense bone bridges between 1st and 2nd and 3rd and 4th Lumbar vertebrae on the right side.

In the late cases, a great many cases are first seen with massive bone bridges, anteriorly and laterally (see Cases 27—60—67), where the patients complain of weak and painful back, etc., so that we see that there is something to the problem besides bony fixation. This something, we believe, is fixation in the proper position or posture. In correcting the older cases, the only discomfort is due to the stretching of the abdominal muscles; after they are stretched, there is no complaint.

We aim to accomplish (1) correction of deformity by stretching the anterior muscles and ligaments; (2) getting the patient up in a cast that will hold him while allowing enough function to promote hardening of the bony structures and toning up the soft tissues, and at the same time, permitting the posterior group of muscles and ligaments to undergo compensatory shortening.

In the early cases, without cord involvement, this process takes about six months. I have coal miners back at work in six months' time. (See case 38). Plate No. 24.

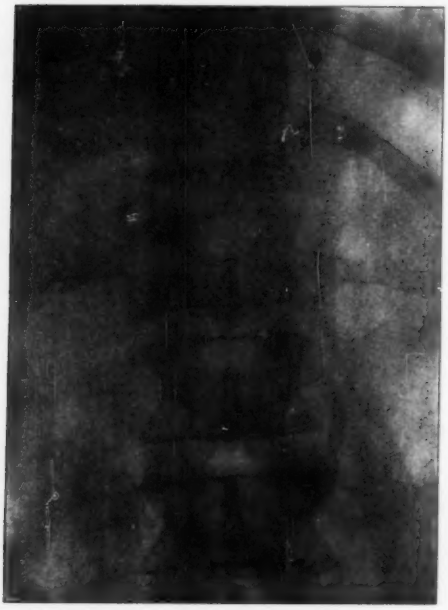

PLATE No. 28.—30.. Mr. J. L. Aged 45 years. Coal Miner. Fall of slate; patient complained of no back symptoms whatever. C. C. being injury to left knee. Dislocation of semi-lunar cartilage. Diagnosis of back condition made from history and by physical findings. First set of pictures negative; sent back for 2nd set; was found. Has bone bridge on left side connecting 1st and 2nd Lumbar bodies. Crush bottom of 1st and top of 2nd Lumbar.

In the late cases, six to nine months are required in the younger individuals, and nine to twelve months in the older individuals.

We do not think it is necessary to use any form of internal splinting, because (1st) We have seen in our studies that bony fixation is present in a great many cases in the location where it can do the most good and that patients still are not cured.

(2nd) Bony fixation in the spinous processes prevents motion beyond that necessary for healing and to an extent amounting to more or less disability afterwards.

(3rd) Bone grafting is unnecessary from the time-saving viewpoint because the cases in which we have put bone transplants had to be held as long as the ones that we did not graft. We have placed transplants after Albee's method in five cases and fused one case after the method of Hibbs.

(4th) All operations on the spinous processes interfere with the soft structures and give additional shock to a patient that has already suffered great shock.

PLATE No. 29.—60. Mr. J. S. Aged 39. Miner. Fall of slate; treated in hospital for fractured ribs. Went back to work, but could not work on account of shortness of breath. Had marked angular deformity. Was a crease in his abdomen of overlapping skin 1 inch deep. A marked crushing of 1st Lumbar with strong anterior bone bridge between 12th Dorsal and 2nd Lumbar. This case illustrates that nature has healed the fracture by strong bone bridge, but that the other problem of treatment, the correction of deformity and maintenance of correction, has been disregarded.

Early Treatment of Fractured Spines.—First:—Morphine should be given in fairly large doses for 3 or 4 days to combat delayed shock. Second:—Patient's back should be immediately immobilized to prevent further wounding of soft parts and shock in the transportation to hospital.

Diagnosis:—The following points should aid in diagnosis.

First:—The history of an acute flexion of the spine, as a heavy object forcing the head and shoulders forward, sometimes so that the head approaches the legs, will fracture the spine in nine cases out of ten.

Second:—Prominent spinous processes or angular deformity.

Third:—Localized tender spinous processes.

Fourth:—Limitation of motion.

Fifth:—X-ray; both antero-posterior and lateral views must be taken.

One should always see the plates himself as the plates taken may just miss the site of fracture and be reported back negative.

Sixth:—Sixty per cent. of fractures of the spine are in the lower segment of spine from tenth dorsal down.

CONCLUSIONS.

First:—Many fracture-crushes of the spine, without cord involvement, are unrecognized. A great many physicians think that if a man can walk he has not fractured his spine, and treat him for sprains and contusions of the soft parts.

Second:—The majority of fracture-crushes of the spine receive no adequate treatment. They are allowed up after periods of from one to eight weeks in bed without any support and gradually break down and deform. It is highly essential, no matter how long patient has been in bed, that he have adequate support in order to restore, partially at least, the normal function of the spine, while at the same time preventing the occurrence of deformity until the return of full function is permissible.

Third:—We have found that the spinous processes of the fractured vertebrae will be tender until the healing of the vertebra has taken place and all strain has been taken from it.

Fourth:—It is very easy to fracture a vertebra if weight is applied to the top of a slightly flexed spine.

Fifth:—All cases of fractured spine should be corrected and put in the best position and then held in that position until nature has repaired it. This should be at least six months.

Sixth:—It is unnecessary to do any operation on the spine for internal fixation.

Seventh:—Every case of suspected fracture of the spine should have a thorough x-ray examination, and that means plates taken antero-posteriorly and laterally.

DISCUSSION OF PAPERS OF DRS. AYER, MIXTER AND WALLACE.

DR. WALTER DANDY, Baltimore: We must all be greatly impressed with this beautiful conception of Dr. Ayer; also with the brilliant results which it has brought about. The method, while simple, is not a fool-proof procedure. One cannot help but think of the danger of inserting the needle into the cisterna magna. I have long wanted to use this method. In fact, I have been in communication with Dr. Ayer for some time for some possible value of it in brain surgery. It takes a good deal of nerve to insert a needle into that region, but we have seen from Dr. Ayer's work that it can be done in competent hands without danger. It should not be used by one not skilled in its use. This probably is only the beginning of a large field which will be developed by its use. He has brought out the value in intraspinous growths, and of course with difference of pressure above and below there can be no doubt as to whether you have or have not an intraspinous subarachnoid block. There are other conditions in which we get an intraspinous block. I have been greatly impressed with it in hydrocephalus; inflammatory processes that involve the meninges of the brain also affect the meninges of the cord, and one can get a block in the intracranial subarachnoid space or ventricles and have a second block in the arachnoid of the spinal canal. It would be of tremendous assistance if one could use a cisternal puncture in cases of brain tumor. I recently had a tumor in the spinal canal just below the cranial canal, a case which I felt sure was a brain tumor. There was choked disk, headache, vomiting, etc. The ventricles were of normal size. I explored and found nothing. The case finally came to autopsy. We found a tumor which blocked the spinal canal just below the foramen magnum. By a cisternal puncture alone could we have made a diagnosis on an intraspinal rather than an intracranial tumor.

There is one thing I should like to ask Dr. Ayer. I am wondering whether he can *localize* a growth; after making a diagnosis of an intraspinous growth by subarachnoid block, can he also make an accurate localization? If he can do that, this method would be of paramount importance. I think this is one of the outstanding contributions of many years. It has impressed me tremendously.

Dr. Mixter's paper also interested me very much from a neurologic standpoint. I think we must all conclude pretty much as he has done. We are unfortunately dealing with a lesion in which our diagnosis is far behind our operative procedures. I presume in less than ten per cent. of the cases in which a laminectomy is done is the patient benefited, but we have no way of eliminating those in which the operation cannot be of help. We must strive to make a better differentiation between complete severings of the cord and physiologic block, or those cases in which there is complete destruction of the cord and those in which there is only temporary block due to edema or pressure. In this connection I wonder if this procedure of Dr. Ayer might not be of value to us. I feel very much as Dr. Mixter does, that all cases of complete block of function, those in which there is a complete paraplegia, should be explored very early—the earlier the better. I also feel, as we all must, that there is a period, whether it is 24 hours or whether it is a week—certainly it is no longer than a week—in which good can be accomplished in a certain percentage of the cases, and after which nothing can be done. After ten days or two weeks I do not believe anything can be done in injuries to the spine except in the nerve roots of the cauda equina. I feel pretty much against any refinements of laminectomies. I feel the one big thing is to get a thorough exposure of that spinal cord and to remove all

possible causes of injury, either now or in the future. I feel definitely against a hemilaminectomy or any of the partial laminectomies. Moreover, certainly in a considerable percentage of these cases, there is very marked dislocation of the vertebrae, producing constriction of the spinal canal, so that the spinal cord is under direct compression of the laminae of these vertebrae. That being true, the laminae play a pretty important part in the continuation of this pressure. I feel it more important to remove these laminae which are producing, definitely in many cases, constriction of the spinal canal, and thereby injury to the spinal cord. I think it is very much better to be safe in the all-important matter of clearing up the spinal cord from any possible injury from the spinous processes. The important thing, I think, is, as Dr. Mixter has brought out, to get your cases early and make an early diagnosis, and then make a very complete and thorough treatment. We must hope that it will be possible to make a diagnosis beforehand, between lesions which can be helped by operation and those which cannot. It is rather discouraging to do so many operative procedures on a more or less empirical basis, and that is certainly the condition as it exists today.

There is also a group of cases which Dr. Mixter has brought out and which is well brought out in the work of Allen. These are cases in which the spinal cord is punctured. We have all seen cases in which the spinal cord is perfectly intact, but in which the interior is macerated. Later the spinal cord becomes thinned and ruptures to let that macerated, necrotic material escape into the spinal canal. In a week or ten days after the trauma this necrotic material may often be seen floating in the cerebrospinal fluid. Doubtless it would be a good thing to do what nature herself must later do: to nick the spinal cord into this necrotic centre, as Allen advises. This form of treatment must await the results of many observers. I think we can all agree that the important thing is to get the patient in the first 24 hours, and at present information can be gained only by exploring all doubtful cases.

I am not prepared to make a discussion of Dr. Wallace's paper from a pathologic standpoint. One is impressed by the results that Dr. Wallace brought out. The fact that impressed me was that these cases came so late, and that there was almost an inverse ratio between the latent period in which the diagnosis was made and the time in which treatment was necessary. The time necessary to produce results is double in the later stages. One is very much impressed with the rationale of the method. It is determining accurately the cause of this condition and the institution of rational methods directed toward correction of the cause.

Dr. C. L. Starr, Toronto, Canada: These three papers have been of tremendous interest to me, and I am quite sure it is a great satisfaction to all of us to hear of the work that has been done by these gentlemen who have presented these papers. I think this work will go a long way toward helping us in deciding what should be done in this type of case. I must confess that I am rather a pessimist in the operative procedure in these cases. The proposition of Dr. Ayer has interested me immensely. I think if it were possible for Dr. Ayer to tell us that in the hands of Tom, Dick and Harry it could be made safe it would add definitely to our armamentarium. In a large series of cases of spinal injury, spinal disease, spinal growths, we have, since we have known of Dr. Ayer's work, been tempted to try his methods, but we have not had the courage to do it on living patients, though some of us have tried it in the Anatomic Department. We have contented ourselves so far with spinal puncture and studying the character of the fluid. As he has so well pointed out, the type of fluid is only partially helpful. The find-

ing of the yellow-colored fluid is not very helpful, because it means that the condition has gone beyond the possibility of much, if any, relief being expected. The study of the pressure, however, is valuable. We have unfortunately not been using a water manometer, but a mercury manometer, which is more difficult to handle. We have found that the pressure is very frequently high. The startling point was that it was so easy to lower the pressure. A small amount of fluid withdrawn will drop the pressure almost to nothing. This impressed me with the fact that you have inhibition to cerebrospinal flow. Where this block is, it is hard to determine. It might be in the Sylvian aqueduct, or it might be in the spinal canal, but that does not help very much toward localization. If we have some other localizing method it might help us to that extent. I am only voicing the sentiments of all my own colleagues who have followed the work of Dr. Ayer, in congratulating him on the work thus far accomplished, and in hoping that he may so far advance it that it may be made safe in the hands of our house staff.

I was also interested in the presentation of Dr. Mixter, and I think his presentation and the presentation of Dr. Wallace, if I interpreted them rightly, show that they are rather inclined, with certain exceptions, to operate on most of the cases in the earlier stages. I am not convinced that it is possible to demonstrate in any case whether you have a complete section of the cord or, what in my mind is equally unsatisfactory, a crushing injury of the cord. In both cases the symptoms of a complete section—that is, a physiologic block—are present, with so little hope of recovery that the patient is pretty nearly useless in future life. The other cases illustrated, of involvement of the cord, which unquestionably get well without surgical interference, are to a very large extent of a different type. Then he has a smaller series with improved chances of recovery by fixation. I cannot agree with him as to the method of fixation which he suggests. Wiring the spinous processes together is not a good type of fixation. Neither do I think that a spinal graft or any kind of a graft is a good means of fixation. It seems to me the problem is the same as in any other fractured bone. Immobilization by plaster bed is as good a method as it is possible to get with the expectation that the fracture will unite and the recovery will be as complete as though operative procedures were introduced. My experience is largely in cases of this character. I looked up 33 cases of laminectomy in cases which have come under my observation in the General Hospital of Toronto, and of these 33 I am quite sure that not one of them was benefited by operative procedures. Dr. Mixter claims four out of 52 improved, but this is a very small percentage which have improved very definitely; and those I am not sure would not have improved if no operation had been performed. In spite of the fact that I listened with a good deal of interest to Dr. Mixter's presentation, I am still inclined to feel that, given a case of fracture which can be fairly definitely or even moderately accurately diagnosed as a complete or even partial lesion, the patient has a better chance of recovery if the spine is properly fixed, and I think Dr. Wallace's method of fixation is probably as good as anything that can be done. If the x-ray shows bone fragments impinging on the cord, this is an indication for operation. We have been using plaster moulds—the "Gypsbett" of the Germans, putting the fracture up in the hyperextended position. I wonder if this does not fulfill the suggestion of Dr. Dandy equally well.

I wonder if we are absolutely certain that the edema, which does play a very large part in pressure of the cord in the early stages, will not subside in a reasonable measure, with the possibility of the rest of the cord getting relief from the localized pressure. I wonder if we are perfectly sure that the

edema will not subside with quite as large percentage of relief as if we removed the laminae. I have not seen any case of edema with pressure of the laminae sufficient to make a mark on the cord, which I think is fair evidence. I must confess that my whole attitude may be one of pessimism, but it has been over a fairly long period of time and with a fairly large number of cases, most of which have come to autopsy. Take, for instance, the case Dr. Dandy spoke of in which there was no loss of continuity visible on exposure of the cord, yet on autopsy you will find the cord is so destroyed that the patient could not recover under any circumstances, operative or non-operative. Those cases, I am fairly persuaded from autopsy material, are the ones in which you will find complete section of the cord. Whether those cases will recover to a greater extent after laminectomy is done, I doubt. We have all seen in our war experience cases with evidences of spinal cord pressure which later recover. I am sure we could get recoveries in civilian life. I am still of an open mind on this subject, and if a procedure were presented which held out a very much larger hope of restoration than we have seen, I for one would advocate it with both hands. On the other hand, I do not think it is right to advocate surgical intervention where there is no likelihood of recovery. For that reason alone it seems to me one might be rather hesitant in accepting it.

The sad commentary on Dr. Wallace's paper is that 50 per cent. of the fractures of the spine were undiagnosed.

Dr. J. M. Spellissy, Philadelphia: Dr. Mixter and Dr. Dandy both mentioned the name of Dr. Alfred Reginald Allen. His work on Lesions of the Spinal Cord was experimental, and upon dogs. He performed laminectomies, and then dropped weights at graduated distances upon the naked cord. He increased the weights and distances until paralysis invariably resulted.

He next operated upon a second group of dogs, using the standardized weight and distance, but, as soon as the cord was contused by the weight, he immediately made a mesial, antero-posterior incision with a special, delicate knife at the site of injury.

Dr. Allen's point was, that the swelling following the contusion of the cord —usually within a dense and unruptured dura—should be immediately relieved. In the second group of dogs, so treated, recovery without paralysis ensued, in contrast to invariable paralysis from the same weight at the same distance in the first group of dogs.

Prior to Dr. Allen's report of his work, with exhibition of the dogs, a patient came under my care with complete paralysis and a fractured spine, from a fall from a height. Dr. Charles K. Mills, the neurologist, saw the patient in consultation and suggested that the incision of the cord take place according to the method which Dr. Allen then was investigating, as the patient had received his injury but a couple of hours before the consultation. Dr. Allen not only was present at this first performance of his incision upon a human cord, but lent his own special knife, and assisted by useful suggestions. It was probably within six hours after the injury that the incision was made. It established, first of all, that it did not harm; secondly, the event was temporary improvement in sensation, and perhaps a little in motion. As the injury was high up and of severe character, the man died at the end of some ten or eleven days.

These facts emphasize that if this procedure is to be of service it must be immediate. The dogs operated upon at once recovered, and when exhibited were able to jump several feet from the floor. On the other hand, the man operated upon at an interval of a few hours, experienced but little relief

from the same procedure, though it must be borne in mind that the insult received was probably much more violent than that experienced by the dogs.

Spinal injuries, low down, have much better prognosis. I have seen a woman, two or three of whose lumbar vertebrae were crushed by her being doubled up in a folding-bed accident. Instead of making use of the appliance reported at this meeting by Dr. Wallace, she was turned prone on a hammock with extension to the feet, and a plaster dressing applied. Uneventful recovery, with no paralysis, and subsequent discarding of her celluloid jacket, followed. Another instance was that of a man with partial paralysis and kyphotic deformity in the lumbo-thoracic vertebrae, from pressure on the head. He was treated with extension, and later a brace. A year after he was found not only to have completely recovered from his paralysis, but to have discarded his brace, and to be lifting 50-pound weights in his work, without distress.

The high spinal injuries usually require immediate laminectomy. The experiences of Drs. Starr and Mixter emphasize that of most operators, that laminectomy does no good in a very high percentage of cases. May this not be because they are not operated upon early enough before compression of the nerve cells within the cord has hopelessly damaged them?

Dr. Willis C. Campbell, Memphis: In 1915 I reported in the *Interstate Journal of Medicine* six cases of fracture of the lumbar spine without compression of the cord. Since that time we have observed a great many more, not only of the lumbar spine, but also in the cervical region. If a man has a very simple fall, a very extensive fracture may occur. In one case a young man walking down the street slipped on a banana peel and sat on the buttocks. He was able to get up, and in ten days' time he had considerable deformity. The x-ray picture showed a very definite compression fracture of the first lumbar vertebra without paralysis. I have had one case in the cervical region in which a young woman had a very slight injury, in some way twisting her neck in turning over in bed, and the x-ray showed a definite dislocation of the cervical vertebrae. I have also seen cases in which the patients were riding in an automobile, and on passing over a bump were thrown to the top of car, landing on the buttocks, producing a fracture of the cervical vertebrae. I think we should observe such injuries very closely.

In the spinal column we are dealing with spongy bone, and fractures in spongy bone are sometimes quite difficult to handle, more so than fractures in dense bone. We have more continuous pain, osteitis may exist over a long period of time, as has been noted by Nathan in fractures of the foot. Here we have the same type of bone as we have in the spine.

Another point that I have observed in these cases, is the confusion with tuberculosis of the spine. I have seen quite a number of very definite fractures of the spine that have been diagnosed as tuberculosis of the spine. In one article in which cases of tuberculosis of the spine were reported, I am sure, in analyzing those cases, that a great number were due to fracture, and not to tuberculosis. The x-ray findings are quite similar, as you know.

As to the treatment of this type of case, the conservative treatment, I believe, should be followed first. You very frequently will have a fixation, but there are quite a number of cases that do not improve by conservative measures. In that type of case we must use internal fixation. It might be true that fixation of any kind does not improve all cases. There are very few operative procedures that will give 100 per cent. results.

Dr. A. H. Freiberg, Cincinnati: I rise to ask Dr. Ayer whether he has observed any change in pressures when there is a marked change in the axis of

the body from the horizontal, when the manometers were in place; in other words, what effect does it have if you raise the axis of the body 45° from the horizontal, while the pressures are being observed?

Dr. John L. Porter, Chicago: Regarding the immobilization treatment of spinal fractures, because of my connection with a number of large industrial and insurance concerns, I see a large number of spinal fractures, usually long after the fracture has occurred. I find that practically all of these cases have had no treatment whatever, and in many cases the symptoms have been so trivial at first that the diagnosis was not made. To illustrate how serious an injury the patient may have without immediate symptoms, I want to cite a case of a young colored boy of 21, who was employed by a packing company. While pushing heavy trucks into an elevator—these trucks are mounted on four wheels—the elevator suddenly went up, and he fell down three stories. They went down to pick him up, thinking he was dead. He had picked himself up. He was referred to the office of the chief surgeon, who insisted on his going home. He did, but reported for work the next day, complaining of a little pain in his back. The chief surgeon brought him to me. That is one of the few cases I have seen immediately after injury. We had an x-ray picture taken, which showed a marked compression fracture of the last dorsal and first lumbar vertebrae. I sent him to the hospital. When I reached the hospital the man had not gone to bed. We succeeded in putting him to bed. The next day he was up walking around the ward, and he said he was not going to give up time when there was nothing wrong with him, and against the advice of all of us he went home, and the last I knew, had gone to work.

The feature that has struck me in all of these cases is that if they are not immobilized, no matter how well they apparently are, they have pain for from six to eighteen months afterwards. I have also learned by experience that no matter how long after the fracture, if they are immobilized by such a method as Dr. Wallace describes, the pain disappears.

Dr. C. E. Thomson, Scranton: Last November I had a crushing fracture of my second lumbar vertebra. That is my only excuse for being before you, regardless of the fact that I have done more than one hundred laminectomies. Lest I should be limited to time, I should like to mention in connection with Dr. Starr's remark and Dr. Wallace's paper that there are only about 50 per cent. of those fractures diagnosed. I have a point in diagnosis that I think is somewhat important. I demonstrated this point to the Boston meeting, but, inasmuch as there may be some persons here who were not at that meeting, I may be excused if I repeat it. A man sustains a fracture or an injury to his spine and has pain particularly marked in the sitting posture. Put him in an arm chair, and let him take the weight off his spine by raising his body from his arms on the arms of the chair, and his pain is relieved; let him sink back into the chair, allowing the weight to come on the spine, and the pain returns. That, I believe, is a very important point in the diagnosis, particularly of crush fractures of the body of the vertebrae. I fell sixteen feet out of an apple tree, rode back to town in an automobile, and went to bed and remained there practically all the time for four weeks. I say practically, because I went to the bathroom and did a few little insignificant surgical operations during the four weeks. I then made myself a plaster jacket, which I wore four months. I believe I am in a better condition than if I had been on a Wallace spring or any other fixation apparatus for six months. This is consistent with what we have learned of fractures during the war,—not to

confine them too long, but let them have some movement. I have some pretty-looking adhesions (bony) between the bodies of the vertebrae. I do not suffer any inconvenience. I wore my plaster cast about three or four months.

I would like to say a word or two about laminectomy.

DR. PORTER: How long after you were hurt before you put on the plaster?

DR. THOMSON: I did not have a plaster jacket on while I was in the recumbent position. About one month after I was hurt I put it on. I would like to make an appeal for a class of patients who by all diagnostic evidence are hopeless. We do not know when a patient is hopeless with a fracture of the spine. I think we get benefit, Dr. Starr, from all laminectomies if for no other purpose than that our patients get better treatment than if they were pushed off to die. If these patients are hospitalized and their bladder drained by external urethrotomy, which, I think, is very important, because so many of them die with infected bladder in the first month if they are not drained, a goodly number of them will recover even though they are considered hopeless cases at first. When we take the precaution and trouble to do a laminectomy, we are especially interested in the patient, and he is not pushed aside to die, which I am here to protest against.

DR. R. T. TAYLOR, Baltimore: I have half a dozen slides I would like to show. An interesting case that came under my observation was as follows:

This patient was a little girl, S. M., six and a half years old, who, on November 29th, 1913, was sitting on a log, watching some men cutting down a large tree. The tree fell on her, and she was bent double, and pinioned to the log under her. Upon being released, the child fainted, was cyanosed and could breathe only with difficulty. She was revived, but it was immediately evident that she was paralyzed from the waist down, and on more careful inspection, a knuckle was seen at the first, second, and third lumbar vertebrae, projecting backward beyond the surrounding parts three-quarters of an inch. The child was soon carried to a hospital, where an eminent neurologist, the surgeons and family physician concluded it was inexpedient and dangerous at that time, owing to the extreme shock, to consider operative relief. The x-rays then made, showed fracture of the arches, and such close approximation of the first and third lumbar vertebral bodies that the body of the second vertebra was dislocated to the left, through an arc of nearly ninety degrees of rotation, with fracture of the articular processes and laminae of that region. This produced a marked flattening of the spinal canal, from before backward, with bony constriction of the cord and upper portion of the cauda equina. Careful neurological examination made at that time showed complete motor paralysis and anaesthesia, from the fracture down, with retention followed by incontinence of urine and feces from paralysis of the sphincters. Much trouble was experienced later by a tendency to impaction of the bowels. The child was placed on a Bradford bed frame, and the trunk was steadied by sandbags, and she remained at this hospital until January, the condition remaining unchanged, except that sensation returned to the front of the pelvis, the upper third of the thighs, and the gluteal region. The incontinence was distressingly annoying, and only with great diligence could bed-sores and chafing be prevented. The case was referred to me on April 9th, 1914, when I first saw her, and I had her admitted to the Kernan

Hospital for Crippled Children. On examination there seemed to be at that time some return of power in the psoas and iliacus, the anesthesia was unchanged, but her feet were in talipes equinus, and if the child was put in an erect position, the knees were hyperextended (genu recurvatum) and likely to give way just as we see in complete paraplegia from anterior poliomyelitis.

On May 22nd, 1914, under a rectangular lateral skin flap, laminectomy was done, six months and twenty-five days after the accident. The arches of the first, second, and third lumbar vertebrae were removed after biting away with rongeurs the spinous processes, which were found to be firmly ankylosed and fused together. The dura was much thickened, and no pulsation in the vessels in the lower part of the cord and cauda equina was appreciable until the thickened membranes had been well dissected away, above and below. At birth, the cord extends to the lower margin of the last lumbar vertebra, and in this small child the cauda equina was seen to begin at the middle of the third lumbar vertebra. The wound was covered only by the skin flap, which was closed with a subcuticular silver stitch. For two or three weeks after the operation the region of the skin flap bulged and fluctuated like a large spina bifida, and then flattened out. The kyphosis was removed of course by the operation. Progressively, the power began to return in the legs, aided by thorough daily massage, and later the reflexes, which had been absent, could be elicited. The anesthesia cleared up more slowly, and for at least two and a half months after the operation the soles of the feet, the back of the legs and thighs, and the region of the anus were anaesthetic. Finally by September 1st, 1914, the control of the sphincters was fully restored. On September 7th tenotomies of the Achilles tendons were done to relieve the equinus, and on October 30th the child was discharged cured, wearing stop-joint ankle braces to prevent a recurrence of the contracture of the heel cords.

Of spinal injuries, 60 per cent. are fracture-dislocations, 20 per cent. fracture alone, and 20 per cent. dislocation alone. In my experience, the cervical and dorsal regions are more frequently injured than the lumbar, and the higher the lesion the more serious the case, and the greater the operative risk. Adult males, in middle life, more commonly suffer from these spinal accidents than females or children. Compression fractures in the lumbar region were rather common in my service at Fort McHenry, and recovered with fixation. Authorities differ as to the proper time to operate, but the consensus of opinion favors early operation. With the absence of reflexes, Bowlby, Thorborn and Herter advise against operation, whereas in the present case the reflexes were absent, yet recovery ensued. With the severest spinal cord injuries, viz., puncture, laceration, etc., one finds a few successful cases following immediate operation. Lauenstein advocates waiting six to ten weeks for natural repair aided by head and foot traction, fixation by plaster corsets, and, in selected cases, by manipulative reductions under anaesthesia. Horsley advises operation if immediate extension does not reduce the deformity. In 168 cases analyzed by Burrell, in 1894, 22 per cent. recovered by expectant treatment, and 33 per cent. recovered after operative treatment. Gault, in 270 non-operative cases collected, found the mortality 80 per cent. Thorborn, in 61 operative cases gave a death rate of 50 per cent.

Dr. S. Fosdick Jones, Denver: I have been particularly interested in hearing the papers presented by Dr. Mixter and Dr. Wallace, and I wish to speak of a series of five cases of compression fracture of the spinal column with cord symptoms, which have recently come under my observation. It

has been my experience that frequently compression spinal fractures have been at first mistaken for back sprains, or contusions, or mild types of osteoarthritis. A careful and thorough examination should in every instance be made in case of vertebral injuries, and a skiagraph, taken in both the antero-posterior and lateral views, is essential in determining the precise nature of the injury. I agree with Dr. Wallace that the radiographic interpretation should not only be made by the radiographer, but also by the surgeon in charge of the case.

There are five chief points to be emphasized in the skiagraphic examination of compression fractures, and at least two of these points must be present before a definite diagnosis can be determined:

First, the presence of angulation, which may be either a lateral angular deviation or a posterior angulation.

Second, a lateral deviation of the column at the site of the fracture.

Third, and most important, is the diminished intervertebral spacing between the segments of the column.

Fourth, compression of the entire body of the vertebra or of the anterior portion of the body.

Fifth, the presence of an angular kyphos, seen in the lateral radiographic view.

Diminished intervertebral spacing and the presence of either lateral or posterior angulation must always exist, in my opinion, before one is warranted in making a positive diagnosis of spinal compression fracture.

The first lantern slide taken from an x-ray plate of a typical compression fracture of the ninth dorsal vertebra occurred in a man who fell down a mining shaft, a distance of fifty feet. Upon examination following this injury, there were no spinal cord symptoms present. His only subjective symptom was pain on forward flexion of the column, and pain on pressure over the spinous process of the ninth dorsal vertebra. The skiagraph showed a marked compression of the ninth dorsal vertebra, and diminished intervertebral spacing and a slight posterior angular deformity. Immobilization, very similar to that outlined by Dr. Wallace, was carried on for a period of three months, followed by the wearing of a Taylor brace for eight months.

The second case was that of an ex-soldier, who, while serving in the A. E. F. in France, fell from a moving freight train, sustaining an injury to his back, which was diagnosed at that time as a sprain. After ten days in a hospital, he was returned to duty. Eight months later, after his discharge from the Army, having resumed his duties as a postman, he presented himself for examination, complaining of pain over the mid-dorsal spine, and on lifting heavy weights. The presence of the slight angular kyphos, with a compression fracture of the eighth dorsal vertebra, can be seen in the skiagraph.

The third case was a fracture of the first dorsal vertebra, showing a lateral deviation of the fractured dorsal segment and an anterior bridging of bone between the first and second dorsal vertebrae.

The fourth case occurred in a railroad clerk who had fallen between two cars, and was considered to have sustained a sprain of the back and a sacro-iliac relaxation. The examination clinically and by x-ray showed a compression fracture of the second lumbar vertebra, with marked diminished intervertebral spacing and with no cord symptoms.

The first case: I am indebted to Dr. Hart of Denver for permission to show the skiagraphs of a man, who while in the Army met with a spinal injury, which, at the time, was tentatively diagnosed as a compression fracture of the fifth lumbar segment. The examination by Dr. Hart demonstrated

clearly no evidence of a compression fracture, but showed a distinct bulging of bone between the seventh, eighth and ninth dorsal segments, with an angular kyphosis and a lateral deviation of the dorsal column.

I also want to emphasize a point, that in those cases of compression vertebral fractures, that the development of Kuemmel's disease, described in 1895, the symptoms appear late, following vertebral injuries, as a result of falls, and that the symptoms of fracture of one or more segments of the column may not be manifest for several months or even after one year following the original spinal trauma.

It is most important, therefore, that in every case of severe spinal injury, that a careful physical examination, with a neurological and skiagraphic examination, should be made.

Dr. Roland Hammond, Providence, R. I.: I would like to emphasize the importance of taking a lateral view of the patient as he lies on this bed. Ordinarily the patient is turned on the side, in order to take the lateral view. If you are going to regard these as two fragments, and the reduction of the fracture is accomplished by the frame, as Dr. Wallace has suggested, then the x-ray should be taken as the patient lies in bed. This is not only for the purpose of diagnosis, but to follow the progress of the case.

Dr. J. B. Ayer, Boston (closing his part of the discussion): It is very gratifying to me not to have more opposition to a method which must be considered as potentially dangerous. It is of interest that most of the adverse criticism has come from surgeons, the medical men accepting the procedure more readily.

Dr. Freiberg asked whether we had used the method with different positions of the body. It is impracticable to carry out the procedure with body erect; frequently, however, the patient is in bed, with 10° or 15° elevation of the head, and it is easier for him to remain in that position; in such cases the pressures in the manometers rise to the same height under normal conditions, although the needles are not on a horizontal plane.

In regard to Dr. Dandy's question about localization. Naturally that is the next step for demonstration. Thus far I have a few data that help in localization, but of less value than clinical observation. We have tried, as he has, injections of air into the subarachnoid space, but thus far unsuccessfully. Perhaps this method may be developed. Unfortunately, I know of no substances impervious to x-rays which are safe to introduce into the subarachnoid space.

On Dr. Starr's remarks I shall take a little longer. He wants, as we all do, a fool-proof method which will give us the same results as combined cistern and lumbar puncture. If lumbar puncture alone is performed with an eye to getting all that can be obtained of value in this connection, I believe that we can do without cistern puncture in nine cases out of ten. As Dr. Starr has said, lumbar puncture is usually performed without a manometer, or with a mercury manometer, which is not satisfactory in these cases. Then the fluid is examined for cells, globulin, and Wassermann, whereas a test for total protein is the most significant.

I may summarize the tests obtainable on lumbar puncture alone of greatest significance in suspected spinal subarachnoid block as follows: Careful dynamic tests, using a glass manometer of approximately 2mm. bore, observation of pulse oscillations, which are diminished or lost in block, respiratory oscillations which are diminished in low block but much increased in cervical or upper thoracic block, and, most important of all, the effect of jugular

compression on the height of the manometer column, producing in block no rise, or very slight rise, after a latent period. The amount of fluid obtainable is also of significance; sometimes less than 5 c.c. can be obtained below a block. While the usual tests should, of course, be performed on the fluid in the laboratory, an estimation of the total protein, best quantitated with sulphosalicylic acid as precipitant, is the most significant test, and one which is usually omitted. The color is also of significance, and xanthochromia is frequently missed unless the fluid be observed carefully. In early block or where the spinal cord is only slightly compressed, the above tests may be only doubtfully positive. In such cases greater certainty is obtained from combined puncture.

Dr. W. J. Mixter, Boston (closing his part of the discussion): I think the discussion has brought out the fact that we are still dealing with an unsolved problem. My own feeling is that a number of cases will be benefited by laminectomy, particularly if combined with the laminectomy there is incision of the cord in the early cases, as advocated by Hamill. I believe that selected cases only should be subjected to laminectomy.

Sometimes, for some reason or other, a graft is inadvisable, possibly on account of the bad condition of the patient, and possibly because laminectomy has been performed. There is no question in my mind that where possible to insert one, the graft is the best means of fixation, where fixation is indicated.

I wish to thank the Society for the privilege of presenting this paper.

THE END-RESULT IN FOUR CASES OF SEVERE DESTRUCTIVE INJURY TO THE HIP.*

BY TOM S. MEBANE, MAJOR, M.C., U.S.A.

THE end-results of severe destructive injuries of the hip are not only interesting but instructive. Most cases of severe injuries of the hip are followed by ankylosis or a flail joint. The four cases reported below are remarkable in that a useful joint resulted in spite of considerable loss of substance and prolonged infection.

CASE 1. Pvt. C. S. (Figures 1, 2, and 3.)

This patient received shrapnel wounds of left hip and hand in action on the Champagne front October 6, 1918. The hand was amputated.

FIG. 1

FIG. 2

*From the Orthopaedic Section, Walter Reed Hospital, Washington, D. C.

FIG. 3

The upper end of the femur and acetabulum were badly shattered and infected. Repeated operations were required, and wound drained until June 29, 1921, when healing occurred.

The patient walks with a cane, and has an excellent range of motion at the hip. The passive range of motion is that of a normal hip. Actively, standing, the patient has 40° flexion, 10° extension, and approximately 15° abduction and adduction. There is no pain referred to the joint. There is good stability. The 3½-inches shortening has been compensated for by raising the shoe.

The patient is greatly pleased with the result, and considers himself much more fortunate than his comrade in the next bed with an ankylosed hip.

CASE 2. Pvt. J. S. M. (Figures 4, 5, and 6.)

Patient received a high explosive wound of the right hip in action on the Somme front September 29, 1918. The compound comminuted frac-

FIG. 4

FIG. 5

ture was badly infected, and the wound drained for two years. Repeated operations were necessary to provide drainage and remove sequestra. Six months after healing had occurred an attempt to remove the head and put the upper end of the shaft in the acetabulum had to be abandoned on account of the excessive bleeding from the old scar tissue. After recovery from operation the patient wore a walking caliper for four months. Caliper was then discarded, and for four months before discharge patient walked with a cane. For the past month patient has been taking daily walks of several miles without ill effects.

Examination at time of discharge: Patient walks well, and sits down without difficulty. Passive range of motion at hip normal except for loss of abduction. Active range of motion standing 30° flexion. The 2½-inches shortening of the leg has been compensated for by elevating shoe. There is complete ankylosis of the knee.

FIG. 6

CASE 3. Pvt. W. H. (Figure 7.)

Patient received a machine gun wound of left hip in action in the Argonne October 4, 1918. The compound comminuted fracture of upper femur and acetabulum was badly infected. Several operations were required before the wound finally healed in August, 1921. On several occasions since small areas of local heat and tenderness have developed and small sequestra have been removed.

Up until recently patient has been walking with aid of crutches. Examination revealed an excellent range of motion with stability and freedom from pain. He is now learning to walk with a cane, and muscle power is rapidly returning. Nearly complete fibrous ankylosis of the knee exists, and the leg is three inches short. The shoe has been raised to compensate for the shortening.

CASE 4. Pvt. A. K. (Figure 8.)

Patient received multiple shrapnel wounds in action in Russia February 4, 1919. The most extensive wound was a compound comminuted fracture, with extensive loss of substance of the upper end of the left

FIG. 7

femur. Severe infection had occurred, and when patient reached Walter Reed Hospital, in addition to a draining wound of the hip he had complete ankylosis of the knee and rigid equinovarus deformity of the foot. The left leg is four inches short.

The patient refused to consider amputation or further operative procedures on the hip. The equinovarus deformity of the foot was corrected and the hip healed without ankylosis. Passively approximately normal range of hip motion existed, and actively, standing, patient had 30° flexion and 10° abduction. The hip was not painful, and stability was good. Patient walks with crutches on a raised shoe. He is very much pleased at still having his leg.

The management of severe injuries of the hip of the nature of the four cases described is a difficult problem. These cases solved their own problem and are satisfied with the result. They can get about without braces. They can sit comfortably. They are free from pain. It had been our intention originally to attempt ankylosis or head of the fibula

FIG. 8

transplant after sufficient time had elapsed, but, much to our surprise, under the stimulus of use the muscles shortened, and nature manufactured a joint. It is doubtful if any better, if as good, a result could have been obtained by operation. Operation would have been difficult on account of bleeding from the scar tissue. Lighting up of the old infection would probably have occurred. Further shortening of the leg would have been inevitable in all cases.

These cases are instructive in that they demonstrate that considerable loss of substance of the upper end of the femur can be followed by a fairly satisfactory functional result. They also demonstrate that this result can occur in spite of prolonged infection. These results show that extensive resections of the upper end of the femur, in adults, for severely infected fractures, are justified. They would suggest also that it might be justified in severe tubercular or septic disease, in which mortality is high, recovery slow, and tendency to permanent organic damage by amyloid degeneration is great.

THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP.

BY E. H. BRADFORD, M.D., BOSTON, MASS.

Forty years ago there was no thorough, satisfactory method of treating a congenitally dislocated hip. In contrast, today, the question to be discussed is the percentage of cures offered by the different methods used, in one the choice being between a method involving dissection and one requiring manipulation alone, and another in selecting the most suitable manipulative method. The question is not only as to the ease of possible reduction, but also as to the stability of the reduced head.

Sufficient data are at hand to justify generalization. The present paper is based on the records of a considerable number of operations, both manipulative and by incision. In previous papers statements have been published mentioning different methods employed chiefly at the Boston Children's Hospital. In this paper later conclusions are recorded.

The subject was first called to the attention of the medical profession in Boston by Dr. Buckminster Brown, fifty years ago, who reported a case at the time supposed to be successfully treated by a modification of the Pravaz method, that is, by several years' recumbency with prolonged traction accompanied by massage and daily manipulation. Later Dr. Post attempted manipulative reduction according to the Bigelow method used in traumatic dislocations. Since then all known methods, operative and non-operative, have been employed at the Boston Children's Hospital on a large number of cases, carefully observed and recorded. From this material, generalizations have been possible and various observations from time to time reported, comprising notes on two hundred or more cases treated between 1900 and 1914.

Several papers have been published by the writer reporting the results of operation in these cases examined two years after the end of treatment. In the present paper, the condition of several patients observed ten or fifteen years after the cessation of treatment is presented and is thought to be of interest as indicating the ultimate results. These cases are not selected cases, but are those of a few where accurate information happened to be obtained as to the ultimate functional result.

C. M. Single congenital dislocation of the hip. Age 25 years. Operated upon when five years old by manipulative reduction with mechanical aid. The result 20 years after operation showed a perfect cure with no limitation of motion at the hip joint in any direction. The young lady excelled in all school athletic gymnastic exercises and was noted for excellence in grace and figure.

S. C. Double congenital dislocation of the hip. Under observation for some time at the State Hospital School, Canton. One hip reduced by manipulative reduction with mechanical aid and permanently cured. The right hip was reduced and relapsed and was cut down upon. Motion perfect in the left hip. Some limitation in the right hip. Walks with a slight limp. X-ray shows the development of an abnormal acetabular rim, slightly higher than normal on the hip cut down upon. Patient is engaged in domestic service, and with the exception of the limp in the right hip is free from disability.

G. S. Age 17. Operated upon when two and one-half years old; manipulation. Hip slipped. Later cut down upon and hip reduced by open incision. Motion perfect, except abduction slightly limited. One inch shortening. Hip firm. Trendelenberg test shows even line of buttock. Thickening over trochanter. Health and activity normal. Patient walks without limp.

M. Old congenital dislocation of the hip. Twenty-one years of age. Reduced by manipulation at the age of seven years. Motions free. Admitted to Army and served in France. Walks without limp. X-ray shows hip not in socket, and that the normal anatomical relations at the hip joints have not been restored, but the functional use at the hip was proved by military service.

B. 28 years of age. Double congenital dislocation of the hip. Both hips reduced by manipulation with mechanical aids. Reduction in the right hip not stable; subsequently cut down upon. The patient's present condition presents a cure with perfect motion in the hip reduced by manipulation, but a relapse. In the hip cut down upon, some displacement has resulted, giving a slight limp. No further disability.

E. C. Age 16 years. Both hips reduced by manipulation with mechanical aid at the age of three years. Both hips in place. In the right hip cut down upon, marked stiffness at the hip joint with but a few degrees of motion. Position excellent. There is no distortion of figure.

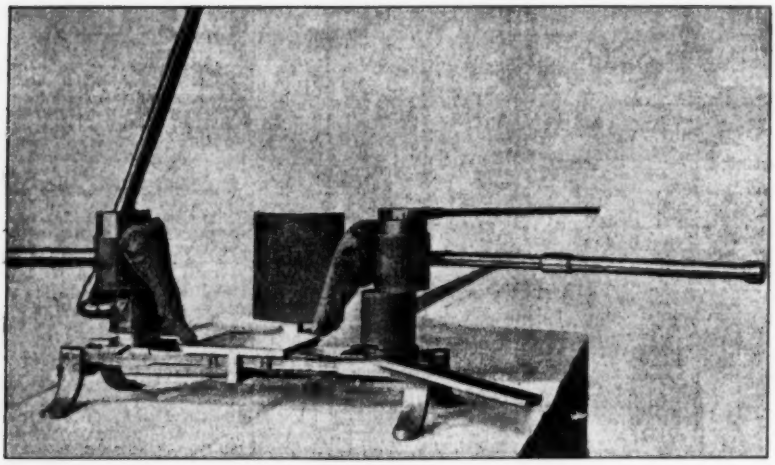

FIG. 1.

LAWYER BARTLETT'S SIMPLE MACHINE.

Designed to make easier the skill of Dr. Lorenz in curing congenital dislocation of the hip, and tried successfully at the Children's Hospital in Boston.

M. F. 25 years of age. Both hips reduced by manipulation with mechanical aid when child was two and one-half years old. Relapse in both hips. Both hips cut down upon. Put in place with careful stitching of the capsule. The after-treatment was interrupted by a severe attack of chicken-pox and later measles, shortly following operation. Neither hip remained in place.

Present condition: Reports after having been struck by an automobile in the right hip. Patient walks with a slight rocking motion. No lordosis or noticeable distortion of figure. No serious injury from the automobile bruise. The patient is able to continue her occupation as a student.

In contrast to this, may be mentioned A. T., age 24, treated when 5 years old for two years by mechanical stretching in bed with traction and traction apparatus followed by gymnastics. Both hips were unreduced and remained in the position of backward dislocation. The patient is short and walks with a slight rocking gait and lordosis and has a somewhat distorted figure. Patient is active and strong; subsequently married and gave birth to a healthy child.

V. M. Age 14. Double congenital dislocation of the hip. Patient operated upon when three and one-half years old. Re-

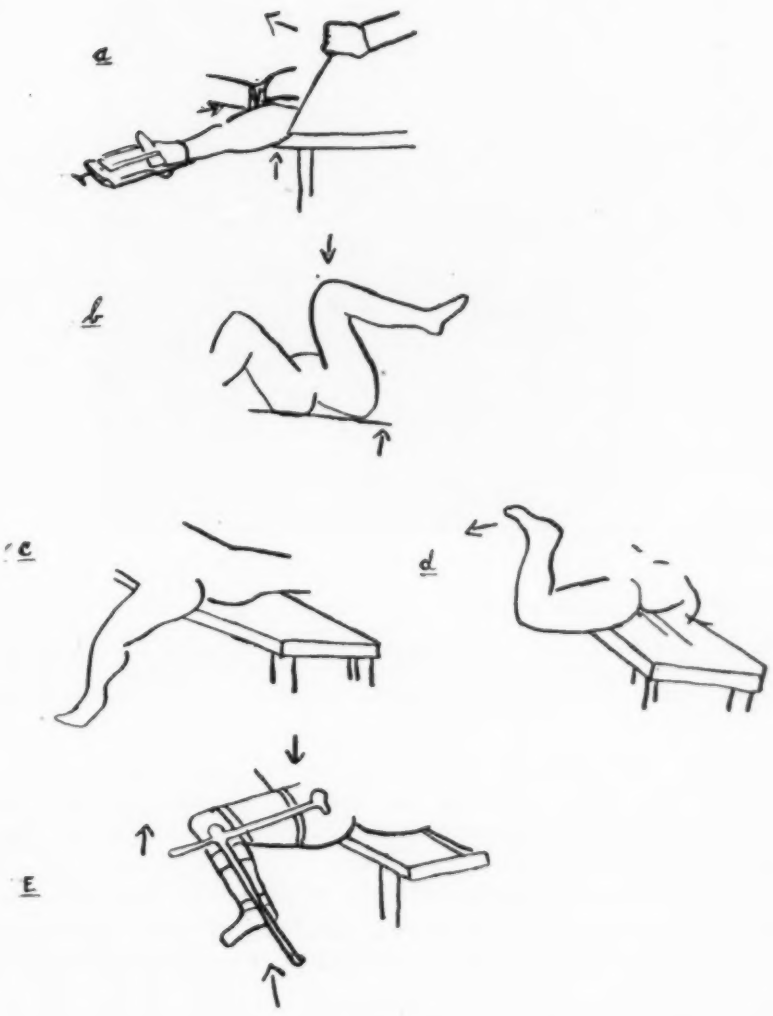

FIG. 2.

a.—Traction and lever applied.
b.—Reduction method by manipulation (patient on back).
c.—
d.—Reduction by manipulation (patient on face).
e.—Manipulating bar to aid reduction (patient on face).

FIG. 3.

N.—22 years old. Milford, Mass. Operated upon for congenital dislocation of the right hip when seven years old by mechanical manipulated reduction. Patient entirely cured. Trendelenberg test normal. Motions free in all directions, except slight limitation in adduction in flexed position. Present condition:—walks perfectly. Has taken a prize for athletic exercises at school.

duced by manipulation with mechanical aid. Both hips in. January 28, 1921: Motion at the hip joints perfect. Limbs of equal length. Trendelenberg test shows both hips in. Ankles and muscles weak. Walks without limp.

These cases are of interest not only because they show the terminal results many years after, through reduction both with or without incisions, but also because it is shown that the cure in successful cases is permanent.

The pathological facts which have been observed indicate that the socket in dislocated hips is retarded in its ossification and development. The ultimate complete cure seems to depend upon the extent of the ossification of the cartilaginous part of the acetabular rim, furnishing a shoulder for the weight supporting the femoral head. In some cases this occurs satisfactorily, in other cases this does not develop normally, as far as can be determined by roentgenograms and functional conditions. Roentgen-ray pictures are known not to be absolutely reliable as

FIG. 4.
N.—Same case. Tracing from an x-ray.

evidence, for being shadow pictures, they are only one dimensional and may apparently show the absence of a hollow socket from the shadow of an abnormally prominent front region or of a socket placed anterior to its normal position.

As the x-rays pass through cartilaginous or imperfectly ossified tissue they give no indication of cartilaginous rims which may hold, even if not visible in a shadow picture. This may explain the fact observed in one of the cases in the above series where no socket is shown, though the young man was passed for military service and served in France,—sufficient evidence of a functionally useful hip. From the roentgenograms reported it appears that there is less perfection in the anatomical cure

FIG. 5.

8.—Operated upon when 2½ years old; manipulation. Hip slipped. Later cut down upon and hip reduced by open incision. Motion perfect, except adduction slightly limited. One inch shortening. Hip firm. Trendelenberg test shows even line of buttock. Thickening over trochanter. Health and activity normal. Patient walks without limp.

after reduction by incision than by manipulation. This can, however, be perhaps explained by the fact that these cases were probably those with the greatest anatomical joint deformity. There is apparently from the cases here seen more danger of stiffness after reduction by incision than by manipulation.

In all these cases but two the result was partially or entirely satisfactory. In one, that of double dislocation with reduction by incision in both hips, reduction by incision was effective at an early age. This may be due to the fact that the patient was attacked by measles immediately after the reductions, and the after-treatment was imperfectly carried out. In this case, however, the patient was freed from lordosis and is active, with only a slightly rocking gait, and her condition is much better than that of the other unsatisfactory case of double dislocation upon whom early non-operative treatment was attempted unsuccessfully.

FIG. 6.

C.—Operated upon by cutting when three years old. Patient is now sixteen years old. Hip is strong. Some stiffness in the direction of flexion (one-third flexion), one-half inch shortening. Walks without limp. Trendelenberg test normal. Slight adduction, three to five degrees. Patient is well and strong.

The deformity of congenital hip dislocation can now be regarded as definitely curable, but considerable acquired skill is required in reduction and after-treatment. The younger the case, the easier the reduction. Only in infant cases is there any reasonable expectation of cure by splint traction treatment alone, as was noted by the writer in one instance. In a few cases of young infants spontaneous cure has been noted (one observed by the writer), but in patients able to walk, operative manipulation with or without incision is necessary. Permanent cure without any limp or noticeable deformity or defect may be obtained by treatment and this is attainable in a satisfactory number of cases properly managed. Few procedures in surgery are as satisfactory in the result offered to the exercise of trained skill, but in a number of instances imperfect results and relapses follow attempted reduction. These are certain to occur if operative details are not carefully carried out and the after-treatment properly directed.

FIG. 7.

M.—21 years of age. Old congenital hip, reduced by manipulation at the age of seven years. Trendelenberg test normal. Motions free. Admitted to Army and served in France. Walks without limp. X-ray shows hip not in socket.

Failure or partial success in attempts at reduction occur if the contracted and shortened ligaments and the distorted capsule are not sufficiently stretched or torn to permit lifting or twisting the head into its normal place in the socket.

In a large number of cases in young children the reduction of congenitally dislocated hips presents little difficulty to a manipulator of skill and experience, but often even in comparatively young cases much resistance is encountered and anyone who has experience will be glad to avail himself of the help of effective mechanical aid, fixing the pelvis securely and furnishing unlimited correcting power, completely under the controlling hand of the surgeon. The hands of assistants, no matter how well trained, are often not completely co-operative in their assistance.

The resistance varies greatly both in amount and in character according to the changes in structure resulting from the abnormal strains

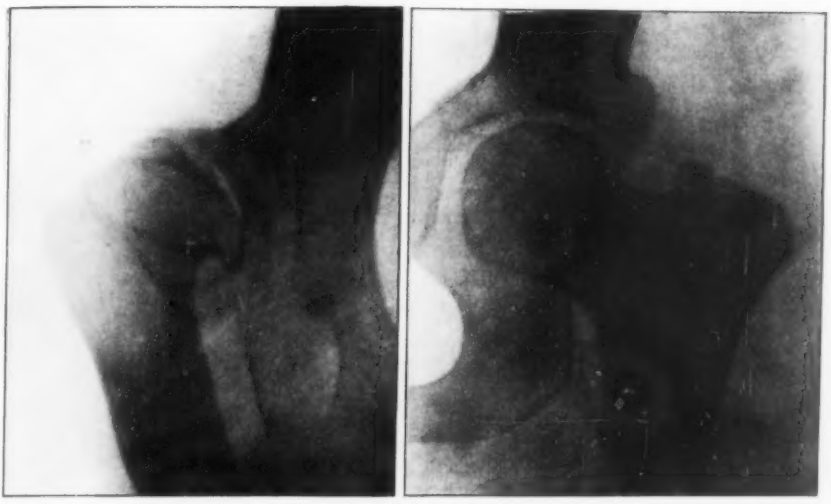

FIG. 8.

C.—Double dislocation. Left hip reduced by manipulation, normal. Right hip relapsed and was reduced by open incision; new acetabulum was formed. There is shortening and a limited amount of motion. Patient working as a domestic. Has slight limp in right leg.

consequent on the disarrangement of the joint. The tissues involved in these changes are, in order of common occurrence:

Shortened abductor and biceps muscles and accompanying sheaths and fasciae including the ileo-tibial band.

Abnormal and shortened periarticular ligaments toughened by the strain of the body weight, the pelvis being slung to the femoral neck and held close to the upper part of the femur by firm, fibrous bands.

A distorted capsule transformed from the normal pouch to a weight-bearing band stretched from the acetabulum to the head of the femur.

Alterations in the stretched capsule from adhesions to the acetabulum, filling it and presenting an obstacle to reduction.

Alteration in the cartilaginous or bone shape of the acetabulum or femoral head.

Flattening and twist of the femoral neck.

In successful reduction all these conditions need to be considered by the operating surgeon.

The reduction of a congenitally dislocated head is a procedure which can be divided into three steps: the stretching or tearing of resistant tissues; placing the head opposite the entrance into the

FIG. 9.
C.—Photographs taken 10 years after operation.

acetabulum; the replacement of the head into the socket through the distorted and sometimes contracted capsule covering the empty socket. The last step may be aided by a pressure on the trochanter near the neck and by a rotating of the femur as it is abducted. This is easily done in smaller children, but in larger and more resistant cases, precision in manipulation is more difficult.

A most useful apparatus aiding the surgeon in the reduction of congenitally dislocated hips was used at the Children's Hospital, Boston, devised by Mr. Ralph Bartlett of Boston, who, having been led to interest himself in the subject, devoted much time and original thought to the problem of effectively stretching the contracted tissues without injury to the bone structures.

The important principle of this apparatus consisted in furnishing a downward pressure on the trochanter and femoral neck while, at the same time, the limb, also pulled with all requisite force, separating the head from the iliac bone, is forcibly abducted. In this way the contracted tissues, *i.e.*, the shortened adductors, the abnormal ligaments, the faulty attached capsule, are so thoroughly stretched that the femoral head having been pulled down to the level of the acetabulum can be,

FIG. 10.

M.—Patient operated upon April 27, 1912. Double congenital dislocation of the hips. Both hips in. Reduced by manipulation with mechanical aid. Jan. 28, 1921. Both hips in. Muscular weakness. Motion at hip-joints perfect. Limbs of equal length. Trendelenberg test shows both hips in. Ankles and muscles weak. Walks without limp.

with a slight skillful manipulative lift and twist, placed in the socket with the stretched capsule kept tense, thus avoiding the interposition of a fold of the capsule in front of the reduced head.

For a full description of this mechanism, reference is made to a publication presented at a meeting of the Boston Society of Medical Sciences. The effectiveness of this apparatus was amply proved by its use in some fifty successful reductions at the Children's Hospital which have been carefully observed and reported. The apparatus, though effective, needed considerable mechanical skill.

The simplest of mechanical aids in the reduction of congenital hip dislocation, the wooden wedge placed under the neck as a fulcrum in stretching manipulation, lacks precision and is liable to cause paralysis from pressure on the sciatic nerve or fracture of the femur. A better mechanism is needed. It is also desired that, as far as possible, manipulation should be employed at the same time that a downward pull is used on the limb and that the pelvis should be firmly fixed.

An apparatus which was employed satisfactorily in a large number of cases at the Children's Hospital by the writer attempts to meet these requirements. It consists of a strong rod with a traction pull operating by means of a padded ankle strap at the lower end and at the upper, working freely in a socket near and below the perineum and secured to the operating table. As the head is drawn away from the pelvic bone there is little danger of bone injury in the needed forcible abduction manipulation. Counter resistance is furnished by two smooth metal uprights pressing against the perineum. A V-shaped steel bar is slipped on these perineal uprights, shaped so as to reach to and press upon the anterior superior spines, preventing the forward tipping of the pelvis during traction.

If the perineal uprights are fixed in a plate which can be screwed on the edge of a table, a simple portable appliance is furnished to which the socket for the head of the traction rod can be attached and the pelvis can be firmly fixed.

In forcibly abducting the limb it is necessary to exert a downward pressure on the upper part of the trochanter and femoral neck to prevent upward riding of the head, diminishing the stretching of the ileo contractile tissues. This can be done, giving, at the same time, to the manipulating surgeon's hand a desired freedom if he is furnished with a strong steel bar, the lower end of which can be fixed in any of a series of holes made in the steel plate carrying the perineal uprights on which the patient's pelvis rests. The surgeon, moving the upper end of this lever, can exert a stretching pressure in any desired direction, pressing the femoral neck or head down or forward as may be desired while traction and abducting manipulations are employed.

The contracted tissues can be stretched with any desired and readily applied force and the head guided through the capsule kept upon a stretch. This is important in preventing the foldings in the acetabulum of the distorted capsule before the reduced femoral head.

With the aid of this appliance, successful and stable reduction has been effected in patients older than is usually feasible by manual manipulation and with comparatively little bruising of the uncontracted tissue. Several cases of from twelve to fifteen years of age have been successfully treated and one patient of the age of twenty-four was reduced by Dr. Soutter with the aid of this mechanism.

In after-treatment the length of time the corrected limb should be kept in the over-abducted position is a matter of judgment; limited motion without weight-bearing should be permitted to the somewhat

abducted limb as soon as it may be supposed that the ligaments and capsule are able to retain the head in the normal position. Too long fixation weakens the muscles unnecessarily. At the Massachusetts Hospital School the abduction traction splint used there in the ambulatory treatment of hip disease has been satisfactorily used after removal of the fixation plaster. With this it is impossible for the head to slip out under ordinary conditions and the slight amount of protected motion permitted acts as massage on the tissues and promotes an earlier return to normal joint mobility.

After the reduction, which should be complete, with the head firmly placed well in the socket and not merely at the border of the rim, it is important to place the limb in such a position as does not favor relapse by the pull of shortened tissues when the limb is put into use, and permitting, while the parts are recovering from the tissue tear incident to reduction, cicatrization of the loose capsule around the femoral neck and the re-establishment of a retaining cotyloid ligament. The problem of the best position is a somewhat complex one and involves a consideration, not only of the twisted neck and distorted head, but also the periarticular ligaments and adjacent muscular fasciae, not overlooking the iliotibial band.

After a traumatic dislocation the reduced hip tends to stay in position, but the congenitally dislocated hip is liable to slip out until retaining tissues are established.

The best position will necessarily be with the limb strongly abducted, as in this position the reduced head is pressed against the bone structure of the socket, while if adducted, a considerable part lies against the weak cartilaginous rim. As soon as the retaining cartilaginous capsular ring has become sufficiently strong for weight-bearing, the abducted position should be changed and the limb restored to its normal position parallel to the long axis of the body. It is also necessary that the great trochanter should, in the period of cicatrization, be kept in the plane of the cross section of the body and not behind it, for in the latter position the torn ligaments connecting the ilium and the lesser trochanter become too short on healing, and the restoration of the limb to its normal standing position would throw the head out of the socket into the so-called anterior position. Furthermore, the trochanter in the frog position is behind the iliotibial band, and the retaining function of the iliotibial band, pressing on the great trochanter, is unutilized and does not force the head into the socket as it does if the trochanter is in its normal place.

A position of the limb in after-treatment, sometimes advisable, is that of strong flexion with but little abduction. The choice of the position of the limb in after-treatment, the change of position, and the length of time before motion is allowed are matters of judgment and cannot be formulated, as they are dependent on structural conditions varying in individual cases. The one to be preferred in each case is that which will hold most securely the reduced head in the socket until the tissues have shaped themselves to meet the strain of normal function.

It is sometimes difficult to determine with certainty whether a complete reduction has been effected at the time of the operation or whether the head is separated from the bottom of the socket by a fold of crumpled tissue. A reliable test is furnished by the tension of the hamstring tendons. These muscles, in congenitally dislocated hips, are shortened and are made tense with the elongation of the limb which follows the placing of the head in the acetabulum, *i.e.*, in a lower position. The shortened muscles are seen in the flexed position of the knee following placing the head well in the socket and resisting straightening the leg. Another important test is the position of the head if reduced. This should be under the femoral artery, and not to the outside.

X-ray pictures, though of service, are not wholly reliable in determining whether or not a complete reduction is accomplished, for the reason that ossification of the femoral head, always incomplete in young children, is even more so in congenitally dislocated femoral heads and acetabula, and consequently the exact relation between the largely cartilaginous head and socket is not accurately shown. This is also true as to the exact condition of the bone structures before reduction, especially as to the shape of the head and the depth or shallowness of the acetabulum. In some instances the acetabulum is situated in front of its normal position, which would give to a shadow picture the record of an absent socket, though in reality it is only misplaced.

The only absolutely satisfactory standard for estimating the results of treatment is the condition in the use of the joint and limb some years after reduction. It can be expected that in practically all usual cases in very young children operated upon before much bone distortion has been established, practically normal joint function will result from careful treatment. In older cases the perfection of the result will depend upon the condition of the bones before reduction and the ability of the tissues to grow to the normal type after more normal use.

In almost all cases if the reduced hip has remained in place after a year of active use it may be considered that the cure is a permanent

one. In a few cases, however, in growing girls relapses have occurred after several years of normal function during the changes in the skeletal growth which occur at the time of puberty, although the reduction was complete as far as could be determined by the evidence of normal function and careful examination several years after reduction. These cases are exceptional and do not affect the general rule that a complete cure is ordinarily to be expected after complete reduction and proper after-treatment.

As no one would be justified in cutting down on an ordinary traumatic dislocation of the hip, so in the usual case of congenital hip dislocation with the present knowledge of manipulative procedures, reduction by means of incision is unsurgical. Formerly, before the nature of the deformity was as well known as it is today, it was thought that no one could be sure of a satisfactory reduction unless the obstructing tissues were thoroughly removed by dissection and incision. It was in this opinion that some fifty cases were reduced by open incision at the Boston Children's Hospital in the series under review. The procedure is a most satisfactory one to the surgeon, as there is no uncertainty of the completeness of the reduction, and the exact condition is not a matter of conjecture, but of visual certainty, but the distorted capsule and abnormal ligaments are so deeply placed that they cannot be reached without a relatively deep dissection involving more trauma to tissue than is to be expected in a skillful manipulative reduction. The resulting cicatrization may, therefore, interfere with a perfect functional result. Furthermore, the procedure of reduction by incision is a more severe ordeal for the patient and involves more risk if the surgeon has not gained considerable experience in the treatment of the deformity. Failure in manipulative reduction entails only bruised tissues, while deep incisions involve considerable dissection and a comparatively large wound. For this reason, the procedure by incision should be reserved for exceptional cases when a relaxed or distorted capsule demands the aid of the knife.

Osteotomy of the upper end of the femur before or after reduction, advocated to overcome the twist of the femoral neck, will be found unnecessary. If the reduction is complete and stable, the muscles adjust themselves to the new relations, and locomotion and joint function become normal despite the femoral twist, a defect which is not uncommon in undislocated hips and which entails only a somewhat posterior position of the great trochanter without interfering with the movement of the joint. Furthermore, as bone normally used tends to grow to type, the twist tends to correct itself after reduction.

Although from the cases mentioned in this paper an impression might seem justified that the results following manipulative reduction were superior to those following reduction through incision, such an opinion cannot be considered as entirely warranted. More care is necessarily required where dissection is needed and the procedure will be reserved for the more difficult cases. After-treatment will also need to be carefully judged to prevent joint stiffness. There is no reason, however, to suppose that with scrupulous aseptic attention to operative details, and the early resumption of protected locomotion, excellent results may not be the rule after reduction by incision as by manipulation.

The existence of bone distortions in the head, neck and socket diminishes the chance of perfect cures, but not of substantial benefit. Flattened and twisted necks may well be left to the vis medicatrix of natural growth in young and even in adolescent cases, but in the rare instances of badly distorted heads unsuited to fit in any acetabulum, reshaping knife or chisel is perhaps necessary, but probably in a shallow socket better functional results are obtained by carefully securing the capsule around than by gouging out a deeper acetabulum. After all such cutting operations, early movement of the limb is indicated with locomotion protected by crutch or splint.

Whether in double dislocations both should be operated upon at the same time is a question of judgment. In the more resistant cases, the reduction should be done singly.

No matter what method any surgeon recommends, it is true that as there is a variety in the resistance met in deformity of congenital hip dislocation, a surgeon should be skilled in several methods of reduction if he wishes to employ the most suitable method in each case, correcting the most resistant obstacle effect as it presents itself. The shortened hamstrings are more readily stretched after the hip is reduced, while the adductors can be stretched during manipulation, but the pelvis should be well fixed and the trochanter pressed down as the thigh is strongly adducted. A contracted and distorted capsule needs not only to be strongly pulled upon, but also to be gradually dilated at the same time by the pressure of the head forced through what remains of the normal capsular sac narrowed at the acetabular rim. Faulty bone conditions of the head, neck, and acetabulum are to be considered in the twist and pressure of the final replacing manœuvre and also in the position after reduction best suited for establishing normal joint function.

Perhaps the most important condition to be considered in reducing a congenitally dislocated hip is the abnormally strong and abnormally

developed ligamentous bands passing from the pelvis to the femoral neck and especially to the lesser trochanter and closely connected with the distorted capsule. It is this distorted tissue which sustains the patient's weight, normally borne by the femoral head in the socket. These ligaments vary considerably in strength and elasticity and for this reason different procedures are serviceable in different cases suited to different degrees and varieties of resistance. These variations can be recognized by the surgeon in manipulating the limb and can be demonstrated on examining pathological specimens of the deformity of congenital dislocation of the hip. This variation in the attachments of the abnormal ligaments, as well as the condition of the distorted capsule is known to any surgeon who has had an extensive experience in the reduction of dislocated hip with the aid of open incision and dissection. The extent of the development of the cartilaginous portion of the acetabular rim and of the cotyloid ligament varies considerably and needs to be reckoned with. This condition can in a measure be determined in the manipulations of the surgeon.

It is apparent that as in the reduction of a traumatically dislocated hip the Y ligament is the important anatomical factor, the key fact in the reduction, so the abnormal ligaments, which may be regarded as distorted changes in the Y ligament, must be borne in mind in the reduction of congenital hip dislocation. Reductions may be affected without recognizing the special importance of these resistant tissues, but in thorough surgical procedure this obstacle is to be carefully overcome if relapse is to be prevented and the best results secured. These ligaments check the ascent and descent of the femur beyond certain limits, but allow considerable motion in flexion, extension, and even ab- and adduction, the dislocated head moving out of, and not in, the socket. This laxity is enough to cause the slipping which gives the characteristic gait but prevents pulling the dislocated head down to the level of the acetabulum. An attempt to overcome the obstructing tissue by dissection is made difficult by the irregular distribution of the ligamentous bands and their insertion on and in the neighborhood of the lesser trochanter, requiring a deep as well as somewhat extensive dissection of innocuous tissues, with resulting stiffening cicatrices.

In the earlier attempts to treat the deformity empirical efforts were made to stretch the tissues, but they lacked precision. Post was correct in assuming that, as in traumatic dislocation, theoretically the reducing manœuvre should be made with the resistant tissue relaxed. These tissues, however, need to be made normal by stretching in congenitally dislocated hips after reduction; otherwise relapse will occur. Pravaz,

Little, and Buckminster Brown, as well as Hoffa (in his earlier attempt at reduction by incision) were not informed through the then lack of pathological knowledge of the existence, in most cases of the deformity, of a competent, but closed, acetabulum. Methods of stretching or tearing the contracted tissues, to be combined by a pulling force with abduction, can be made effective. As has been mentioned, the efficiency of a pulling force can be increased by mechanical aids, especially if the pelvis is properly held.

As the head of the femur in a dislocated hip, if not checked by the capsule, can move in a considerable excursion around the socket, and as the socket rim is less an obstruction at its posterior border than at the upper border, reduction would be more easily effected if the thigh were strongly flexed. The lesser trochanter being held by the shortened ligaments as the fixed point above the acetabulum, by strongly flexing the thigh the free femoral head would be brought opposite the lower and posterior part of the acetabulum and could be manipulated into the socket without opposing the resistance of the shortened tissues. The obstructions which would have to be overcome in placing the head into the socket would be those of the capsular tissues. The remaining contractions in this procedure will be corrected after reduction. This manipulative procedure has certain advantages, but is probably less serviceable in a closely covered socket or a badly contracted capsule.

In reducing a congenitally dislocated hip it is important that the surgeon should not only bear in mind the position of the unreduced head but should be able to exert pressure upon the head or femoral neck whenever such reducing pressure may be needed. It is, therefore, often convenient in less resistant cases to attempt reduction by placing the patient on the face with the limb to be operated upon hanging free, the patient lying at the edge of the table. Pressing the pelvis down on the table helps to steady the pelvis while the surgeon manipulates the limb with one hand and can press with the other hand upon the femoral head. If this procedure is attempted in any but small cases difficulty will be met in easily manipulating the affected limb, giving the requisite twisting and abducting as well as flexing movement when needed. A simple and convenient aid can be furnished by bandaging the limb to a steel bar slightly longer than the thigh, with the leg flexed at the knee to another bar at right angles to the first and socketed to it. The projecting ends of the bars serve as handles aiding manipulation. There is no danger of fracturing the shaft of the femur or of injuring the ligaments of the knee, no matter how much force may be exerted in manipulation, and the surgeon has the trochanter under his hand as

well as the unreduced head under observation by palpation at each step of the manipulation. Pressure can be exerted as desired on the femoral head and on the trochanter directly, while the surgeon is exerting a strong lever-acting force on the rest of the limb.

Preliminary capsule and muscle stretching can be given to the pendent limb by connecting an ankle strap to a stretching rod with a stretching attachment and furnished with perineal counter-resistance.

Reduction of congenitally dislocated hips by the aid of incision, though not advisable in ordinary cases, is a method the surgeon should be prepared to employ in exceptional and difficult cases, and the procedure can be made a most satisfactory one, requiring careful attention to anatomical details and aseptic precautions as well as well-planned after-treatment. Familiarity with the various distorted changes existing in the deformity is needed by the surgeon, who should be ready to meet unanticipated anatomical conditions.

For details of operative technique reference is made to special articles on the subject.

If, as seems probable, the congenitally dislocated hip is the result of a prenatal laxity at the cartilaginous part of the hip joint from incomplete development of the tissues, an absolute cure can be expected after stable reduction and with normal use during the period of rapid growth, provided the reduction is effected before marked changes have taken place from the abnormal use of the imperfect joint, and provided the reduced head is kept in place until the retaining structures have been sufficiently developed in strength to perform the function of holding the head in place. Such an opinion seems absolutely justified by well-recorded results in many clinics.

An absolute cure is to be aimed for in all young cases, and even though normal function is not always gained, marked improvement is to be expected. Operative treatment, to be beneficial, demands, owing to the complex nature of the deformity, unusual care not only in the different steps of the operative procedures, but also in the after-treatment, the exercise as well of sound judgment in delaying, as well as encouraging, the use of the affected limb.

The deformity should be corrected as early as is feasible before active locomotion of the child occurs.

Any treatment before this should consist in the application of a traction abduction splint and in a few cases this may be corrective, but only in the simplest cases.

Reduction by forcible manipulation under an anesthetic is the method of choice in the large majority of cases. This, in resistant and older cases, should be aided by such efficient mechanical aids as fix the pelvis and give the surgeon's hands greater power without hampering the skilled movements of the operator.

Reduction by incision is to be reserved for the cases where manipulative reduction has failed.

The after-treatment is as important as the reduction. The reduced hip should be held in place until strong retaining tissues for the normal position have been established without the development of cicatrical contracted tissues which will tend to throw the head out of the socket when the normal weight-bearing is resumed.

Fuller details are presented in the following earlier articles by the writer. (Congenital Dislocation of the Hip.)

The American Journal of Orthopedic Surgery, August, 1909.

Report of the Staff at the Children's Hospital. Reprinted from the *Boston Medical and Surgical Journal*, Vol. cli, No. 4, pp. 85-92, July 28, 1904.

Twists in Normal and in Congenitally Dislocated Femora, *New York Medical Journal*, December 5, 1903.

Surgery, Gynecology and Obstetrics, August, 1906.

Annals of Gynecology and Pediatry, Boston, November, 1902, Vol. xv.

Zeitschrift f. orthopädische Chirurgie, xxxiv Bd.

The writer would refer especially to two interesting articles in the *Journal of Bone and Joint Surgery* by Dr. Bernstein of Chicago and Dr. Z. B. Adams of Boston.

Conclusions as to the pathology of this deformity have been drawn from the following specimens at the Warren Museum, Harvard Medical School.

9908. *Hip. Congenital Dislocation.* The pelvis and both femora, in fluid.

There is a lack of development of the acetabulum and cotyloid ligament with slight tapering of the head of the femur. These factors rendered possible abnormal mobility of the femur in its socket and consequently an abnormal attitude of the extremities.

From a malformed foetus, 1903. Dr. Samuel Robinson.

10088. *Hip. Congenital Dislocation.* The pelvis and both femora, in fluid.

There is great contraction of the capsule at the neck which shows the difficulty of reduction without incision.

From a child two years old. Both the hips were operated upon by manipulation unsuccessfully. Later the left hip was cut down upon and successfully reduced. Death followed six months later from whooping cough. DR. E. H. BRADFORD.

10088-1. *Hip. Congenital Dislocation.* Half of the pelvis and one femur, in fluid.

It shows the anomalies of the capsule in a case of congenital dislocation.

From a child who was not operated upon. DR. E. H. BRADFORD.

8593. *Hip Joint. Double Congenital Dislocation.* The pelvis and both femora in fluid.

The heads of both bones are dislocated backward and upward, and there has been formed about them a new socket, which is partly fibrous and muscular. On one side an attempt has been made to overcome the deformity by making a new socket for the head. The obstacle to bringing the bone into its new position was the resistance offered by the anterior part of the capsular ligament (Y ligament of Bigelow).

From a child nine years old who died from diphtheria one month after operation. 1894. DR. E. H. BRADFORD.

1418. *Hip. Congenital Dislocation.* The pelvis and both femora, dried.

The necks of both femora are very much reduced in length, standing off from the shaft at a right angle, and end in irregularly rounded knobs, rather than proper heads. The acetabulum is irregular and quite shallow but does not present any evidence of inflammation.

From a middle-aged woman. 1863. DR. D. W. CHEEVER.

6567. *Femur. Congenital Dislocation.* The head and neck of the femur.

The neck is quite short and terminates in an irregular enlargement with small rounded elevations, especially along the edge, but without any proper head.

From a woman 50 years old. 1853. DR. SAMUEL CABOT.

1413. *Hip. Congenital Dislocation.* The os innominatum and femur, dried.

The os innominatum is very thin and light. The cotyloid cavity is irregular in shape. Superiorly, and somewhat posteriorly to its rim is an articulating surface, which was covered with smooth cartilage. The femur is atrophied and the head of the bone has disappeared, and about 2 cm. of the neck remains irregularly rounded at its extremity.

From a woman 60 years old. 1858. Dr. R. M. Hodges.

5200. *Hip. Injury.* A portion of the hip bone and femur.

The acetabulum is small, irregular and shallow, and the dorsum of the ilium somewhat hollowed, but without the least appearance of a new socket. About one-third of the femur remains irregularly flattened, and the neck is much shortened.

From a woman 59 years old who received injury at birth. 1840.
Dr. Homans.

THE USE OF THE INDEX FINGER FOR THE THUMB: SOME INTERESTING POINTS IN HAND SURGERY.*

BY JOHN DUNLOP, M.D., LOS ANGELES, CALIF.

My idea in presenting this case to you today is to bring out some of the more important points of hand surgery which illustrate the functions of the hand. Perhaps the better way to illustrate the points I have in mind would be by presenting the history of my case prior to operation and show the illustrations depicting my operative result.

The case is that of a British officer who presented himself to me with the following condition: he had lost the thumb of his right hand; in addition he had a number of fractures in the carpal area, the wrist was stiff or nearly so in the straight position, and the index finger, due to the destruction of the base of the metacarpal, was somewhat shorter than normal, whereby the metacarpophalangeal joint was retracted. The extensor muscle of the index finger was not functioning and the finger was slightly flexed and abducted under the mid finger. The position of this finger had a great deal to do with the lack of functioning of the middle, ring and little fingers at the metacarpophalangeal joint. With the hand in this condition he had used it but little and there was practically no motion except a slight amount in the two inter-phalangeal joints.

The reason for lack of function of the remaining portion of the hand was as follows: 1—loss of thumb; 2—stiff wrist in straight position; 3—retraction of metacarpophlangeal joint of index finger, destroying the normal arch of the metacarpophalangeal joints; 4—abduction of the index finger under mid finger further interfering with motion of the remaining fingers.

The problem, then, as it appeared to me, was to get the index finger out of the way of the other fingers so that function might be restored in them, and in planning this operation it seemed to me that because of the position and uselessness of the index finger, it was advisable either to amputate it, which the patient wanted done, or to preserve it and use it in place of the thumb which he had lost. It seemed to me that this could be easily done by rotating the metacarpal and the remaining portion of the finger after an osteotomy at the point of fracture and plac-

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

No. 1.

Lateral view, showing ability to oppose index finger against thumb, in reconstructed hand.

No. 2.

Showing power of opposition with index finger used as post. Also shows restoration of function of fingers at metacarpal phalangeal joints.

No. 3.

Showing position of finger used as thumb in the passive position, together with the area of abdominal graft between metacarpals.

No. 4.

Showing position of thumb in palmar view.

Nos. 5, 6, and 7.
General views of hand.

ing the finger in the position of the thumb when taking hold of objects.

It has been clearly demonstrated that the position of function of the thumb, that is, the position of apposition, varies very little; that is, the angle which the metacarpal makes with its relation to the metacarpal of the index finger, varies only a few degrees at any time. It therefore occurred to me that if I could put the metacarpal of the index finger into a position in relation to the metacarpal of the mid finger, similar to the normal relation of function of the metacarpal of the thumb to the index finger, although we might not get a functioning thumb, we should at least get a post against which the flexion action of the fingers could work in grasping objects.

This operation was performed in three stages, the first consisting of separating on the back of the hand the metacarpal of the index and mid fingers and loosening the bone union between the carpal mass and the stump of the metacarpal of the index finger. It was then possible to rotate the finger without in any way interfering with the nerve or blood supply, other than it had previously been interfered with through the original wound.

It was then found that it would be impossible to cover in the space between the two metacarpal bones by any form of plastic operation on the skin, so a skin and fat graft of the abdominal wall was turned up and the lower end of the graft was sewed to the dorsal edge of the wound as far as possible. The hand was then left in this position for thirteen days, the wound in the meantime being dressed daily and kept clean by the use of boric powder. On the thirteenth day, under full anesthesia, the flap was cut off from its attachment to the abdominal wall and the operation of attaching the graft to the area on the hand completed. The abdominal wall was likewise closed. For a few days the last edge which was sewed from the body looked rather angry and there was considerable oozing of an oily substance, which was unquestionably due to fat necrosis, as the subcutaneous tissue obtained contained a very thick fat area. Finally nearly the whole of this surface sloughed loose but did not at any time separate more than half a centimeter. It was kept perfectly clean and healed practically without infection.

Prior to operation the sensory nerve supply and blood supply to the index finger gave it a distinctly bad color and it was without sensation. The base of the metacarpal, due to the frequent handling and dressings, did not become firmly enough united to the carpal area from which it had been broken loose. I therefore decided to go in with an at-

tempt to get bony union in a good position. This was done with the result that I now show you; bony union is not present but apparently a very firm fibrous union.

The result obtained with the material at hand, I believe, is fair. There are certain features in connection with this case which have interfered with a more perfect result; for instance, the stiff wrist in the straight position, a wrist which functionally cannot be in the strong position of dorsiflexion. This in itself clearly militates against a powerful grip; then again the fact that I was dealing with an index finger without nerve supply and with very poor blood supply and with a stiff carpometacarpal joint, all of which interfere with flexion or extension of index finger used as a thumb.

It would seem to me that such an operation could be applied to one whose hand was practically perfect except for the loss of a thumb in which almost normal function could be restored. For instance, I can conceive of a case where an index finger is split off and put in the abducted position with an osteotomy at the base of the metacarpal of the index and where all of the nerve and blood supply is retained and good function of the wrist is present, with the result that we should get a very useful hand. It has been my hope that such a case would present itself, but to date I have not been fortunate in getting one.

I believe that in hand function, other than cases of paralysis, due to nerve injury, we have three very distinct pathological conditions which interfere with good function: first, loss of the thumb used as most thumbs are, as a post against which the grip is made; second, the retraction of the metacarpophalangeal joint which, when present, in all cases restricts function proportionately with amount of retraction, a condition which I believe is not taken sufficiently into consideration in fractures of the metacarpal; and third, the destruction of the wrist joint motion with the joint in the straight position of strength, being about 30° of dorsiflexion.

STRUCTURAL SCOLIOSIS COMPLICATED BY PARALYSIS OF THE LOWER LIMBS—REPORT OF A CASE.*

BY S. KLEINBERG, M.D., F.A.C.S., NEW YORK.

THE following case is reported because of the extreme rarity of paralysis complicating scoliosis. The patient, a girl 9 years old, was referred to me in June, 1921. Her chief complaint was difficulty in walking. The family history was of no interest and was not pertinent to the patient's condition.

History:—The patient began to walk at the age of 1 year and walked fairly well at a year and a half. She was apparently well until two years before her first visit to me, when it was noticed that the right side of her back was more prominent than the left. She was taken to the Hospital for Ruptured and Crippled, where a diagnosis of curvature of the spine was made and a corrective plaster jacket was advised. At that time the patient walked well. Seven months later she again visited the hospital and was advised to join the gymnasium class for corrective exercises. She attended the gymnasium for a year, taking part in the exercises with the other children in the class, and having apparently no difficulty in locomotion. At the end of this period, that is, about five months before she consulted me, the parents noticed that the deformity was more marked and that her walking was awkward and difficult. She tired easily. The difficulty in walking increased and became suddenly aggravated one week before I first saw her.

Examination showed that the child was in good general condition. She presented a marked right-dorsal rotary lateral kypho-scoliosis. The posterior curvature of the spine was more marked than the lateral. There was an unusually marked compensatory lordosis. There was evident shortening of the child's stature and telescoping of the thorax into the abdomen so that there was a manifest disproportion between the height of the trunk and the length of the limbs. The appearance of the back was as is shown in Figs. 1 and 2. There was a recurvature of both knees with atrophy of the lower limbs. She could stand alone but swayed a great deal and sought support. She could walk alone a little, but her gait was very unsteady. She could not bend her trunk forward to the normal degree because she lost her balance.

*Case presented at a Clinical Conference of the Hospital for Ruptured and Crippled, June 6, 1922.

FIG. 1.—Posterior view of right dorsal structural kypho scoliosis. Very marked posterior curvature of the dorsal spine and marked compensatory lumbar lordosis with evident shortening of the trunk.

During flexion of the spine the posterior curvature became markedly exaggerated. There was moderate spasticity of the lower limbs, and marked weakness of the muscles. The upper limbs were not affected. The knee and ankle jerks were exaggerated. She was unable to rise from the sitting position, and was unable to sit up when recumbent. At no time did she have any pain in either her back or lower limbs,—that is, pain of a spontaneous nature or induced by manipulation.

X-ray examination (Figs. 3 and 4) of the spine showed that the 5th, 6th, 7th, 8th, 10th and 11th dorsal and the 1st and 3rd lumbar vertebrae were abnormal. The 5th and 6th dorsal had incompletely fused posterior arches and the bodies were wedge shaped. The 7th and 8th dorsal had no posterior arches. The 10th and 11th dorsal and the 1st lumbar vertebrae showed lack of fusion of the posterior arches while that of the 10th dorsal was very small. There was an interval of at least a quarter of an inch between the lateral masses of the posterior arch of the first lumbar vertebra. The third lumbar vertebra showed a very poorly or incompletely developed posterior arch. In the lateral view, wedging of the mid-dorsal vertebrae was distinctly visible.

FIG. 2.—Lateral view of same case. Shows disproportion between height of trunk and length of limbs. Also marked lordosis.

This was evidently a case of structural congenital scoliosis due to malformation and abnormal development of many of the dorsal and some of the lumbar vertebrae, with an unusual degree of posterior curvature of the dorsal spine. The paralysis was apparently the result of pressure on the dorsal segment of the cord due to the marked rotation and posterior angulation of the dorsal vertebrae. Repeated neurological examinations did not show any intrinsic lesion of the cerebro-spinal axis. The motor weakness was undoubtedly the result of pressure upon the spinal cord. Laboratory tests of the blood, spinal fluid, and urine were negative.

It was decided that the child should be treated as if she had paraplegia following Pott's disease, and for that purpose she was admitted to the Hospital for Ruptured and Crippled. A few days later the weakness of the limbs increased to complete paralysis and she was unable to stand or walk. She was placed on a convex stretcher frame, which was bent to more than the usual degree in order to reduce the posterior curvature of the spine as rapidly as possible. For a long time there was no improvement and I was very doubtful about the ultimate result. At the end of two months she began to move her toes and feet, although

FIG. 3.—Antero-posterior Roentgenogram. Outline of vertebrae exaggerated for a clearer view. Note the very extensive malformation of almost all of the dorsal vertebrae.

during the following month there were many days when she could not do so. The treatment was continued and soon the improvement advanced to a well marked degree. At first she moved her toes; then she began moving the ankles, flexing the knees and, to a slight degree, the hips. Then she began using the gluteals. Soon she could elevate the limbs from the frame, and finally she was able to control the limbs while lying in bed, lifting them and moving them about in various directions at will. A plaster of paris Calot jacket was applied, and standing and walking were attempted. After she had worn the jacket a few weeks she was able to walk. Now the deformity is very much reduced and she can stand and walk without difficulty or effort. She is still wearing a plaster jacket which extends over her shoulders, but it is not

FIG. 4.—Lateral Roentgenogram. Showing very marked posterior curvature of dorsal spine.

of the Calot variety. During her entire stay in the hospital her legs were massaged every day so as to maintain the tone of the muscles and blood-vessels of the limbs.

An analysis of this case brings up the interesting problem of the cause of the sudden increase of the deformity and the resultant paralysis. The actual cause of the scoliosis is the extensive congenital malformation of many of the vertebrae. There can be little doubt, also, that the marked posterior curvature of the dorsal segment resulted in pressure on the cord and consequent paralysis. The more or less sudden increase of the deformity is not so readily explained. It occurred while the patient was taking a course of gymnastic exercises. It may be that the aggravation of the curvature was part of the natural course of this patient's deformity just as many other patients suffer at one time or another an in-

crease in their deformity. But, inasmuch as the deformity got worse while the patient was taking exercises, it is possible (I myself think that it is more than likely) that the increase of the curvature was due directly to the exercises. In common with others I have seen many patients become worse after they had been taking exercises and I believe that in some cases they have a harmful influence. This is due to the fact that mobilization of the spine and increase in the flexibility of the trunk permit greater relaxation and slumping of the body in the interval between the gymnasium periods, and the curvature increases. It is true, of course, that in the majority of instances gymnastic developmental and corrective exercises improve the muscle tone and the patients profit from this work and acquire the ability and habit of holding themselves in a better posture. But in *some cases*, undoubtedly a very small percentage, composed particularly of those with weak musculature and poor posture, the increased flexibility of the spine is detrimental and permits the spine to become more deformed. I have a boy of 18 under my care now who, tired of jackets, left them off and for over a year has been exercising every day. His curvature has greatly increased. Such an aggravation of the deformity is especially likely to occur in cases of single curves of rachitic or paralytic origin. I believe that in the case here reported, where the spine was unstable because of the extensive malformation of the vertebrae, the mobilization resulting from the exercises permitted an increase of the deformity of the spine. This and other experiences emphasize both the need of the strictest supervision of children who are being treated with corrective exercises, and the importance of employing some form of supporting corset until the time when the muscles are sufficiently strong and the improved posture has been retained for a long enough time to make it unlikely that the deformity will increase.

This case is interesting chiefly because of the rarity of paralysis as a complication of structural scoliosis. Dr. Ridlon reported two similar cases in the September 9th, 1916, issue of the *Journal of the American Medical Association* and in a personal communication to me, dated January 12th, 1922, he writes that Dr. Parker of Chicago has a similar case now under treatment. It is interesting also, however, because it suggests the probability that gymnastic exercises may at times be responsible for increase of the deformity. I believe that every patient with a well-marked scoliosis, who is taking exercises, ought to wear some form of supporting apparatus.

SYNOVECTOMY IN CHRONIC INFECTIOUS ARTHRITIS.*

BY PAUL P. SWETT, M.D., HARTFORD, CT.

DURING the period of 1915 to 1921, I have performed fifteen synovectomies on eight patients suffering with chronic infectious arthritis. These patients have been carefully followed, and I wish to present a clinical study of this small series of cases. The operation itself has consisted in opening the joint, generally, at the site of the greatest thickening and effusion, and then with scissors and forceps dissecting out all of the diseased inner layers of the synovial membrane down to what appeared to be healthy tissue. The joints have all been closed without drainage, and with no fixation.

In this study there has been an attempt to follow the Goldthwait classification, and no reference is intended, therefore, to chronic hypertrophic or chronic atrophic arthritis. The differentiation between the types naturally depends upon physical findings and radiographic manifestations, and such illustrations as accompany the case reports will help to establish the validity of the diagnosis.

The theoretical considerations leading to the trial of this operation were three in number. The first theory was based upon the proposition that the surgical foci of infection having been removed, the patient's general state indicating that the activity of the inflammatory process in the joints was subsiding, and the usual means of absorption of the organized inflammatory exudate having failed, there remained the possibility that the manual removal of the exudate might promote the resumption of joint function.

The second theory, which developed later, was that the same procedure might be helpful, not alone by the mechanical improvement, but by reason of the fact that the organized synovial exudate contained microorganisms which were capable of continuing the activity of the process within the joint as well as causing metastases into other and previously uninvolved joints. As a natural corollary to this proposition, it would seem that if one grants the existence of secondary metastatic foci within the joints, there is as much logic in their surgical removal as there is in the elimination of the originating or portal of entry foci. Moreover, since it seems to be true that there is a duel going on within the patient between infection on the one hand and resistance on the other, and since,

*Read at the meeting of the American Orthopedic Association, held at Washington, D. C., May 1-3, 1922.

FIG. 1.—CASE 1. N. B. Antero-posterior view of right knee, six years after the first operation. Note the absence of bony changes.

therefore, the final reaction depends in the last analysis upon the patient's resistance, it naturally follows that the less the amount of infection, the better the prospects of ascendancy on the part of the patient's resistance.

The third theory, which has seemed in some ways to lend further encouragement to the possibility of benefit from synovectomy, has been initiated by Pemberton's work on Metabolism in Arthritis. As I understand it, he has found in his chemical studies that the arthritides show a fairly constant suboxidation process and, apparently, the persistence of this abnormal metabolic state prolongs the arthritis. Hence, one of the aims of therapy must be to stimulate the metabolism, and perhaps the best means for accomplishing this purpose consists in a prompt restoration of function in atrophic disused joints and muscles. If the manual removal of diseased synovial tissue can hasten the restoration of function, it may thus indirectly provide the necessary metabolic stimulant.

The cases, with one exception, were all of long standing, showing

FIG. 2.—CASE 1. N. B. Lateral view of right knee six years after the first operation. Note the absence of bony changes.

marked joint effusion, capsular thickening, and fusiform swellings. The interior of the joints showed the large collection of synovial fluid occasionally cloudy and in two instances pus-like in consistency. The synovial membrane was thickened and dense; sometimes so dense as to cut like cartilage. Organized exudate was always present either in the form of large villous tabs or fringes, or as a pannus extending over the articular surfaces, or as a dense, tough membrane walling off the capsule into compartments. The joint cartilages showed no ulcerations except in one case, and in this the operation was a failure in every way. With this one exception, therefore, it seems evident that the process began in the capsule of the joints, and that the synovectomy was done before any damage had occurred in the cartilage. Moreover, the principal synovial changes were found at a distance from the articular margins. This last feature seems to point to the assumption that there must be a type of chronic infectious arthritis or a period in the development of this disease in which the damage is entirely synovial, and cartilaginous injury is not present. Apparently, this type or stage is clinically distinguishable by

FIG. 3.—CASE 2. A. D. Antero-posterior view of right knee, four years after operation. No evidence of atrophic or hypertrophic changes.

the extensive effusion and fusiform swelling often accompanied by heavy grating on motion or deep palpation. The pathological reports showed chronic inflammatory tissue, and negative cultures were returned in all of the cases. Micro-organisms were found in the stained specimens in only one.

Mechanical improvement in the operated joints was promptly manifested by a restoration of painless function in every case, but in two a relapse occurred very shortly, and in one of these two, re-operations were performed with ultimate, complete recovery. So it may be said that only one was a failure, and that twelve were successful from the point of view of joint mechanics. It is to be noted that the one complete failure occurred in a case which presented certain features differing from the usual type inasmuch as a spondylitis was present in this one case, and in the knees the cartilages were covered with small spots of active red granulations.

These few cases offer very little evidence as to the effects of synovectomy on the general arthritic process, but so far none of the patients

FIG. 4.—CASE 2. A. D. Lateral view of right knee, four years after operation. No evidence of atrophic or hypertrophic changes

has developed any extension to previously uninvolved joints, and six of them have been able to resume their former occupations. Of the remaining two, one was a bedridden cripple, and she is now able to care for herself, while the other is actually worse. With this one exception, all of these patients have gained in weight and strength, and have recovered from their anemic, febrile states, but there is no way of telling whether these changes might not have occurred spontaneously.

A synopsis of the case history of the first patient in this series may help to visualize the type of case.

N. B. Age 19. Austrian. Domestic servant. Admitted to the Hartford Hospital, August 17th, 1915. Complaint: rheumatism. Present illness began in 1911—four years before admission—with inflammation in the mid-joint of the right ring finger. After two years, the process appeared in the right wrist. In another six months the left wrist was involved. Beginning six months ago the same condition began in both

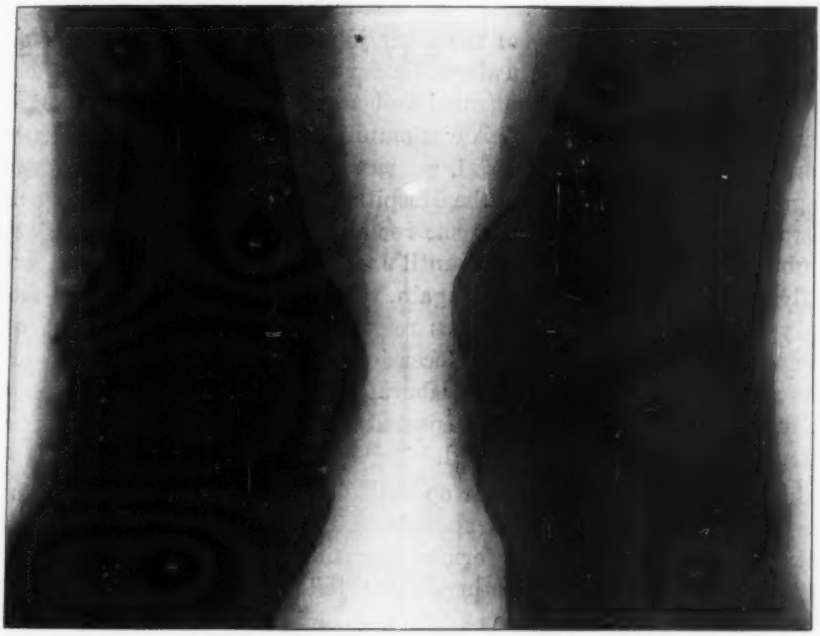

FIG. 5.—CASE 7. J. J. Antero-posterior views of both knees, about two years after operations. The cartilaginous spaces are small but there are no gross evidences of atrophic or hypertrophic changes.

ankles and both knees. A tonsillectomy was performed about the time the last-named joints were affected. When I first saw her there were all the typical features of a severe chronic polyarthritis involving the hands, wrists, knees, and ankles, with marked effusion in both knees. Constitutionally, she presented loss of weight, moderate anemia, slight temperature, and rapid pulse. No surgical focus of infection was discovered. X-rays of the knees were negative for bony or cartilaginous changes. She was bedridden and helpless. Aspiration of the knees yielded cloudy, yellow fluid, culture from which was negative.

The right knee was opened on Sept. 8th, and it was found to be filled with a pannus-like layer of granulation tissue extending over the entire upper portion of the synovial membrane. This was removed with scissors down to healthy tissue, and the joint was closed without drainage. No postoperative disturbance occurred, and the left knee was similarly treated about five weeks later. She was able to get up in the course of two weeks, and began walking with crutches immediately. She was sent to her home on Nov. 6th, where she gradually increased her activities,

and in June it was noted that there was no effusion in either knee, and no signs of activity in any of the other joints. During the summer she resumed her full work as a domestic servant, her weight and general tone were normal, and she continued well until June, 1918, when a relapse occurred in the left knee. This was manifested by an extensive effusion, marked crepitation, and painful, restricted motion. The disability was so great that she returned to the Hospital, where a second partial synovectomy was done in July, and she remained in the Hospital until September. She was well from then until January, 1920, when effusion gradually occurred in the left knee again. In March an extensive synovectomy was performed, and she has remained entirely well since then—now over two years. On every occasion when diseased synovial tissue was removed, it was sent to the laboratory to be sectioned, and to have cultures made. The laboratory reported it as inflammatory tissue, but no culture growth was ever obtained.

I hesitated to suggest another operative attack upon the left knee, but the patient requested it, and spared me the embarrassment. She had been helped so much by the former operations that she had every confidence in the success of another. Her judgment seems to have been substantiated, for on the last examination, March 30th, 1922, both knees presented complete extension, complete flexion, no effusion, and no thickening. The ankles and feet were normal. She had a full range of motion in both elbows, the right showing considerable thickening. There were no signs of activity in any of the joints of the hands or in the wrists, although both wrists were completely ankylosed. Her weight was ninety-three in 1915, and her present weight is a hundred and forty-seven.

To recapitulate, then, it may be pointed out that here is a case of chronic polyarthritis which showed no improvement five months after the removal of the probable focus of infection. Double synovectomy of the knees was followed by a prompt local improvement so great as to enable her to resume her work as a domestic within a few months. Accompanying the local improvement, a general improvement was made, and the inflammation in other active joints became arrested without any direct treatment. This patient has been presented before several members of this Association, and they can testify as to her robust state of health.

I propose to give a very brief résumé of the important parts in each of the remaining cases of the series, having in this fuller account of the one case established in your minds the type of case in which synovectomy has been undertaken.

CASE 2. A. D. Age 38. Female. Lady's-maid. In 1910, she had an effusion in the right knee which was treated by incision at the Charing Cross Hospital in London. The present attack of polyarthritis began in March, 1915, involving hands, wrists, feet, and knees. Tonsils, adenoids and diseased teeth were removed. She made a gradual improvement up until 1918, and was able to do her work, but then her right knee became so painful that she came under my observation. In September, 1918, I did a synovectomy on the right side. Normal function of the right knee returned, and all of the joints improved. The appearance of the interior of the right knee-joint at operation was interesting, as the very large, thickened inner portion of the synovial membrane had formed actual bridges across from the anterior to the posterior portion of the upper parts, walling off several compartments, and effectively restricting motion. A year and a half after the synovectomy, the left knee was similarly involved, and a synovectomy here was followed by excellent results.

She was last observed on April 6th of this year, and she was in good general health, actively at work, the knees being painless and freely movable.

CASE 3. C. C. Female. Age 55. First seen in May, 1919. She had suffered an attack of infectious polyarthritis three years previously. The condition, after removal of diseased teeth, gradually subsided, and all of the joints cleared up except the left knee. Before she was discharged from the Hospital, the left knee was aspirated three or four times, and she appeared to recover. About one and a half years later, however, she began to have recurring febrile attacks with acute pain and effusion into this knee, the attacks coming every few weeks. A synovectomy was performed on the 20th of May, 1919, and a considerable amount of organized exudate was found. In the upper outer quadrant there was a walled-in area containing thick, yellow, pus-like material, culture of which was negative. At the last examination, April 5th, 1922, the knee showed extension to 180° and flexion to 90°, no effusion or thickening. There had been no recurrence of the acute attacks, and she walked well without support.

CASE 4. F. L. S. Male. Age 29. Polyarthritis began in 1912 with sudden onset in the right knee. The knee was drained by his own physician at this time. A year later, the left knee, fingers, shoulders and feet became involved, and two years ago the right knee. Diseased tonsils and diseased teeth had been removed when I saw him. All of the

involved joints showed signs of considerable active arthritis, fusiform swellings, distention of the capsule, crepitation and limitation in motion. The general picture was that of an ill, thin, under-nourished young man. Both knees were subjected to synovectomy, and a large amount of organized exudate and villous material covering the inner surfaces of the synovial membrane in the upper portions was removed. Three months after the operation it was noted that his general condition had improved. There was no effusion in the right knee, and a full range of motion was present. There was a slight amount of effusion in the left knee, but no restriction in motion, and pain was very much less severe than before the operation. One year after the operation, all of the other joints were much improved, and his general condition was vastly better, but there still remained a little effusion, crepitation, and restriction in motion of both knee joints.

Case 5. J. M. C. Male. Age 50. Sudden onset of severe acute polyarthritis in October, 1920. The right knee, the hands, and both shoulders were involved. Very badly diseased tonsils were removed about two and a half months after the onset of the condition. All of the joints promptly quieted down except the right knee, which seemed to be improving under local protection and baking and massage. In the fall of 1921, the knee became less movable, more swollen and more painful, and one of my colleagues performed an extensive synovectomy, and he reported to me in April, 1922, that the patient was in excellent health, with a freely movable and painless right knee.

Case 6. M. P. Age 15. School-boy. October, 1918. Polyarthritis involving the right elbow, right wrist and both feet, five months' duration. Five years previously he had sustained an acute attack of arthritis in both knees, which entirely cleared up. There was a great deal of capsular thickening in the right elbow. A tonsillectomy and synovectomy of the right elbow were done at the same time. Six months later, he presented an entirely different appearance. There was no swelling in any of his joints, and he had complete motion in his elbow and wrist, and his general condition was excellent.

Case 7. J. J. Age 32. Swedish. Domestic. Admitted to the Hartford Hospital, June, 1918, very much crippled with a polyarthritis of four and a half years' duration, involving hands, elbows, shoulders, knees, and feet. This patient was admitted on the Medical Service, and shortly thereafter transferred to the chronic female ward, where she led a mis-

erable existence between a bed and chair. The involved joints were pretty well fixed; the knees were flexed at a right angle. She had to be lifted into a sitting position. In December, 1918, a double synovectomy was done at one sitting, and within the course of a few weeks it was possible for her to get in and out of bed unassisted. She gradually resumed the upright position, and in the course of six months she was able to walk without support, and so far as her knees were concerned, she made a wonderful recovery. There was so much restriction in motion in her shoulder-joints that she was very much hampered in assisting herself to dress and bathe, etc. She was finally discharged from the Hospital, however, in December, 1921, able to return to her sister's home, and get about and wait upon herself in every way.

CASE 8. M. T. B. Age 23. First seen in October, 1915. A very extensive chronic effusion in both knee-joints of several years' duration. I aspirated both knees, and injected formalin and glycerine, and the effusion did not return, and the patient was able to resume his work, and he got on very comfortably until four years later, when he reported that the effusion had recurred in both knees. They were again aspirated, and apparently benefited. The patient returned again in the spring of 1921, and this time there was not only an extensive effusion in the knees, but a beginning spondylitis. A synovectomy was done, but the picture in the interior of the joint in this case was quite different from what had been found in any of the other cases. There was no pannus-like exudate, the inner surfaces of the synovial membrane were red and injected, and over the cartilaginous portions there were small spots of active granulation tissue. These were wiped off, and the joints were closed, but no improvement whatever resulted, and the patient reported in April, 1922, that his knees were very stiff, and that he was practically disabled.

The summary of the important points brought out by this series of cases is as follows: No local damage or disastrous complications have followed the operation; very little reaction, either locally or constitutionally, has been found postoperatively. With one exception a marked improvement in the mechanics of the operated joints has occurred. In six of the eight patients, the operation was followed by a pronounced general improvement, and apparently accompanied by some amelioration of the signs and symptoms in the other involved joints. In one case, there was no improvement whatever, either locally or constitutionally, and in one case the local and constitutional improvement was very slight. It seems to me, therefore, that synovectomy is a procedure which warrants further consideration in cases of chronic infectious arthritis,

and that if the cases are carefully selected, so that the operation is not attempted in other forms of polyarthritis or in cases in which extensive cartilaginous damage has already occurred, we may expect local benefit to follow. A word of warning must accompany any such conclusion, however. This operation cannot, I believe, take the place of other forms of treatment, and it should not be resorted to on any wholesale basis. It should not be undertaken in any case in which the diagnosis is not perfectly clear. Moreover, it should not be undertaken until the originating foci of infection have been eliminated, and sufficient time elapsed to show that improvement cannot be secured by such conservative constitutional means of treatment as are generally practised. Apparently, the operation is most likely to succeed if it is done in the type of case or at the stage of the disease where the damage is entirely synovial, the effusion extensive, and the cartilages are not ulcerated.

DISCUSSION OF DR. SWETT'S PAPER.

Dr. Frank D. Dickson, Kansas City, Mo.: I had the opportunity about a year ago of examining two of Dr. Swett's patients, and I want to give personal testimony to the very excellent results which he secured in these cases. I myself have been interested in this operation of synovectomy in arthritic cases. I have been interested in the question of whether in these synovitis and arthritis cases the joints are not the source, as Dr. Swett mentioned, of active bacterial infection, just as the tonsil or apical abscess in the teeth can be the source of infection; in other words, whether the joint infection may not have been secondary to start with and became the primary source just as may be the case in any other infection. With that end in view, we endeavored to get cultures from all the infected tissues, at the operating table. One case with some points of interest was that of a man who had been treated in the clinic for arthritis. I felt it was a question of an infectious arthritis. I had him examined by an urologist. He gave a history of gonorrhea fifteen years before. The urologist reported that his seminal vesicles were full of pus, and he advised drainage. They were drained, and I am sorry I did not show him after that drainage to some of the members of the Central States Orthopedic Club, who were in Kansas City last fall. Immediately after the drainage there was marked improvement in his elbow, back, and neck. He had not been able to lie down for three years, except with pillows piled under his shoulders. After the drainage he could lie flat in bed. His right knee continued swollen, and I went in as Dr. Swett advocated. There was a tremendous amount of synovial hypertrophy. The joint seemed to be divided into several compartments. Tissue was taken from the joint, and several cultures made on glucose agar aerobically and anaerobically. We got a growth in those cultures anaerobically. They were carried through from one inoculation to another, from the 17th of December, and were still alive January 18th. The report of the pathologist was that the cultured organism was probably gonococcus. An attempt was made to reproduce this condition in rabbits and various other animals, but we failed there. These experiments are incomplete, but there seems to be no question

that in this joint there were bacteria present, because numerous cultures were made, and they all follow out. We carried them through as far as reproducing the condition in animals. The cultures from the joint contained bacteria which resembled the gonococcus culturally. The man has continued to improve and has pretty nearly normal function in the knee, and is back at work.

I have tried in several other cases without success, for there are a great many difficulties encountered in getting cultures made which will grow. It is only by care that we succeeded at all. I hope to continue along this line, and have something to report next year. There is something to indicate that these synovial hypertrophies may contain in them definite bacterial foci, which may continue to produce changes. I might relate one case. I had done a synovectomy, and in closing up the skin I used a pair of pointed scissors, and punctured my glove with the tip of the scissors. These had been used for only one purpose—to dissect out the synovial tags. In six hours I had the most beautiful cellulitis up my arm. This is not very scientific. The table was sterile, and the only thing I touched was the tip of the scissors that I had used to clean out the synovial membrane.

DR. J. O. WALLACE, Pittsburgh: I saw Dr. Swett's cases at Hartford, and I want to say that he is doing good work. There was one patient that I remember who was very much crippled, and who was getting around apparently without any pain. I myself have operated on one case since, a man with both knees and one ankle involved. There was swelling above and around the knees. I opened up one six months ago and took a culture. There was no growth after seventy-two hours, but the report of the pathologist was acute and chronic inflammation. I did the second knee about ten weeks ago. This man has improved in his general condition. I think the good that is obtained from this operation is the removal of a great, large area of diseased tissue.

DR. PAUL P. SWETT, Hartford, Conn. (closing the discussion): I have nothing to add except with regard to the question of lippings of the articular margins, which Dr. Watkins spoke of. I think one should distinguish if possible between lippings that are caused simply by the mashing out of cartilage, and the lippings produced by actual bony overgrowths that one sees in hypertrophic arthritis. As far as I can see, there is no rational basis for this procedure, except in the purely infectious type of arthritis.

CONGENITAL ELEPHANTIASIS OF THE TOES.*

BY HARVEY S. THATCHER, M.D., AND THOMAS WHEELDON, M.D., RICHMOND, VIRGINIA.

HYPERTROPHY of the extremities has been designated by various titles. Some of these terms are lymphangioma, congenital hypertrophy and dilatation of the lymph channels, lymphangiectasis, elephantiasis, etc., depending upon the main pathological change. In reviewing the literature since 1878 many superficial reports have been made without microscopic verification; therefore the exact change could not be determined.

History:—The patient was a colored boy, twelve years old. The third and fourth toes of the left foot had been swollen since he was one year old. There were alternating periods of swelling and tenderness. Upon physical examination the third and fourth phalanges of the left foot were swollen, indurated, and thickened.

X-Ray Description:—Dr. A. L. Grey states that the phalanges of the second row of the outer four toes have only one center of ossification. The metaphysis of the first phalanx of the fourth toe has a developmental irregularity. The bones of the hypertrophied toes are not different from the others. The hypertrophy is confined to the soft tissue.

Operation:—Because of the severe pain, Dr. Graham amputated the third toe.

Pathological Description:

Gross changes:—The toe is much larger than normal (measuring 5.2 cm. by 2.7 cm.), and soft. The surfaces made by sectioning are whitish grey.

Microscopic changes:—There is an increase in the number of sweat glands, adipose tissue, connective tissue, blood-vessels, and nerves, compared with the normal. The various strata are also increased in thickness, especially the epidermis. There is a slight infiltration of lymphocytes.

Discussion:—These hypertrophies may be congenital or acquired. The phalanges only are affected. There must be a congenital defect because the centers of ossification are absent. Virchow considered bone hypertrophy as an occasional lesion. There are no bone changes in the case described.

Conclusions:—There is hypertrophy of the soft tissues.

The evidence suggests a congenital origin.

*From the laboratories of Memorial Hospital, Richmond, Va.

THE CONSERVATION OF MUSCLES IN PARALYTIC DEFORMITIES OF THE FOOT.*

BY PERCY WILLARD ROBERTS, M.D., NEW YORK.

As a result of several years of clinical study I am of the opinion that the field of muscle conservation in deformities of the foot following poliomyelitis is one in which much constructive work still remains to be accomplished. We are, I think, too often content to regard a muscle which has not functioned for several years as hopelessly paralyzed, and, as a logical sequence, we are too ready to resort to ankylosing or tendon-mutilating operations as the best solution of an unfortunate situation.

It seems to me that the problem of the paralytic foot in the child is not merely one of overcoming the deformity, but of correcting it by such means as will leave the least handicap to the social and economic progress of the patient in later life.

Obviously, if this objective is kept in view, a stable, flexible foot is more to be desired than one which functions without elasticity. The stiff foot may be a useful member so far as locomotion is concerned, but it compels certain limitations of activity which must necessarily leave an imprint on the development of the individual.

To illustrate my point let me outline three cases. The first is that of a school teacher of twenty-three who for more than twenty years had limped through life with an extreme calcaneus deformity, and in her home town was known as the "teacher with the lame leg." As there was no apparent power in the calf muscles on the affected side I advised astragalectomy. During a subsequent examination, however, I observed that the flexor hallucis and common flexor were strong, and, applying a theory which will be discussed later, I suggested that we try the experiment of shortening the tendo achillis. It was made clear to the patient that this would mean the use of a splint to protect the gastrocnemius from strain for at least a year and also an indefinite period of muscle training. The tenoplasty was done and the after-treatment faithfully carried out. Three years after operation this young woman's calf measurement had increased over two inches, and she now walks in low shoes without perceptible limp. She is no longer called the "teacher with the lame leg."

*Read at the meeting of the American Orthopedic Association held in Washington, D. C., May 1-3, 1922.

The second case was that of a woman of thirty-two, who for thirty years had worn a brace for a paralytic equino varus of extreme grade. She had no control over her foot except slight flexion and extension of the toes. To all who saw her walk she was a conspicuous cripple. On my history card of this case I have recorded that astragalectomy was advised. By the time she came for operation, however, I had observed the result in the case just cited, and therefore it was decided to lengthen the tendo achillis and remove a wedge from the outer border of the tarsus to correct the varus. Two years have passed and this patient now has a good foot with a very fair range of voluntary motion, and she is able to wear an ordinary shoe. Her mental attitude toward life has been strikingly altered for the better because she no longer considers herself a cripple.

The third patient, a large boy of sixteen, was in the Hospital for Ruptured and Crippled three years ago. He had a marked paralytic varus of twelve years' duration. Previous surgical measures having been followed by a recurrence of the deformity, he was scheduled for a radical bone operation. At my request, Dr. Gibney was good enough to revise his initial decision and consented that I should lengthen the tendo achillis and shorten the peronei. A year later the boy became a leader in school athletics, excelling in baseball and basketball. The psychological effect of changing an ambitious youth from a crippled observer to a successful contender in strenuous games needs no comment.

All of these cases were instances of stretched muscles, which, though functionless for from twelve to thirty years following attacks of poliomyelitis, were not paralyzed. There can be no doubt that these patients are happier and will develop along more normal channels than if they had been subjected to the ankylosing operations at first contemplated, which would have resulted in definite limitation of their activities.

The dictum of the firm, restricted foot has guided us in our choice of operation in paralytic deformities largely because there has been no generally recognized means of foretelling the possible return of power to functionless muscles. Profiting by the cases cited and by others of similar nature, I have formulated two simple theories which, if not infallible, are nevertheless of distinct service in solving the riddle of latent power in muscles which have long been inactive.

The first of these is the self-evident truth that a muscle which does not function after an attack of poliomyelitis is not necessarily permanently paralyzed, and the second, that where a group of muscles is supplied by the same terminal nerve no one member of the group is

likely to be completely paralyzed if the others have gained approximately normal power.

These theories have been applied in about one hundred operated cases with results which indicate a very practical degree of dependability. They have, indeed, been responsible for the development of a most satisfactory operation for a certain type of paralytic valgus, to which I particularly desire to call your attention, and also for some work on calcaneus deformities which may be referred to in passing, although the study has not proceeded far enough to warrant definite conclusions.

There frequently occurs a type of valgus deformity in which the tibialis anterior is functionless, and in the movement of dorsiflexion the foot is drawn outward by the action of the common extensor in spite of vigorous effort on the part of the extensor hallucis to maintain the median position. It will be observed that we have here one muscle, the tibialis anterior, apparently paralyzed, with the other two of the group supplied by the deep peroneal nerve functioning well. Applying the theories just referred to, we assumed that under such circumstances the tibialis was probably not hopelessly paralyzed, and that its inability to function was due to the fact that it had been stretched and had suffered from the atrophy of disuse. It was further assumed that shortening the tibialis and transplanting the common extensor to act upon its tendon would restore the stability of the foot.

Putting these assumptions into practice, we have evolved an operation at the Hospital for Ruptured and Crippled known as "reinforcement of the tibialis anterior." In sixty-six cases treated by this method on the Second Division of the Hospital by twelve different surgeons the results have on the whole been so satisfactory that the operation has become routine practice in all valgus cases where the common extensor and the extensor hallucis have regained a serviceable amount of strength. There results from this procedure a well-balanced foot, and it has been interesting to note that two or three months after the splints are removed definite return of contractility can be demonstrated in the tibialis muscle.

In cases of calcaneus deformity the problem is more difficult, both because there are no other muscles on the posterior aspect of the leg which approximate the gastrocnemius and soleus in strength, and because development of the latent power of functionless calf muscles requires many months of intelligent coöperation on the part of the patient. However, I am satisfied from my experience with "the teacher with the lame leg" and from several cases in which reinforcement of

the calf muscles has been successfully accomplished, that there are a very considerable number of instances in which conservation of the posterior muscles will give an ultimately more useful foot than any form of ankylosis.

Success in our effort to reinforce the calf muscles will depend somewhat upon the ability of these structures to regain a portion of their normal contractility when suitable mechanical relations are established. That a useful amount of power may return to the calf muscles appears certain from the results disclosed in the examination of a series of 25 cases in which astragalectomy had been done from six months to nine years previously for calcaneus deformity. It was found that in cases where there was no voluntary control of the toe flexors there was likewise no control over the calf muscles. On the other hand, where the flexors of the toes were active there was a return of power in the gastrocnemius which could be rated from fair to excellent, and there was usually a definite relationship between the strength of the two muscle groups.

These observations lend support to the theory that a muscle which does not function after an attack of poliomyelitis is not necessarily paralyzed, and also to the contention that no single muscle of a group supplied by the same terminal nerve is likely to be completely paralyzed if the other members of the group have regained nearly normal power. In practice I believe the application of these principles will be of service to those who are interested in the conservation of muscles in paralytic deformities of the foot.

A VISIT TO SOME OF THE ORTHOPAEDIC CLINICS OF EUROPE.

BY ARTHUR STEINDLER, M.D., F.A.C.S., IOWA CITY, IOWA.

MILAN.

THE OSPEDALE MAGGIORE at Milan is an enormous institution which contains 3,000 beds. It is planned on the pavilion system, the mechano-therapy being housed in one of the pavilions. I found this department extremely well-equipped with Zander machines and other mechano-therapeutic implements of all sorts. The physician in charge devotes his entire time to mechano-therapy and physiotherapy, and his patients are assigned to him from all departments of the house as well as from the large out-patient clinics of the hospital.

The Istituto dei Rachitici of Milan is one of the two largest orthopaedic institutions in Italy. Situated on a quiet and unobstrusive thoroughfare, the Via Vigentina, it is modestly hidden from open view by a number of doorways and courts which have to be crossed before the main buildings of the institution are reached.

It was founded in 1881 and was then the second orthopaedic institute in Italy, following closely that of Turin. The first funds for the maintenance of this institution were raised as early as 1850, with the avowed purpose of constructing an orthopaedic hospital for crippled children. The main building was erected in 1881, and has been greatly enlarged since that time. Professor Ricardo Galeazzi, the present Director, is the successor of Panzeri, ably assisted by Professors Bassetta and Scarlini, as well as by the Assistant, Dr. Guido Nastrucci. Professor Galeazzi's work is recognized as among the best in Italy. Through the courtesy of Professor Galeazzi and Dr. Nastrucci, the writer was able to gain quite an accurate insight into the activities of this institution. It is laid out in the pavilion system, and has a capacity of 250 to 300 beds. The center pavilion serves for operating suites, for the plaster of paris work, the radiography, photography, and for the care of postoperative cases. Another pavilion is devoted to postural gymnastics as well as the department of scoliosis, which has a special gymnastic equipment and special record rooms.

There is also a pavilion for adult men, one for adult women, and one for children of both sexes. One pavilion is devoted to pathological laboratories, another to the school work, social activities, and dining

rooms. Other pavilions again harbor the so-called *pensionisti*, or pay cases, which seem to be part of the hospital contingent in the Italian institutions which the writer has visited.

Although Milan has no undergraduate medical school, intensive post-graduate teaching is carried out by a chain of institutions called Istituti Clinici di Perfezionamento, the Istituto dei Rachitici being among this chain of institutions which serves the post-graduate teaching.

The writer was particularly interested in Prof. Galeazzi's method of correction of scoliosis. Following Dr. Lovett's principle of correcting the deformity in forward flexion of the spine, Galeazzi has developed an excellent technique of plaster of Paris application, facilitated by the use of a special apparatus constructed by himself, which serves for the fixation of the pelvis as well as the trunk, and which allows rotating the pelvis and trunk in different directions.

The cast is applied in two sections, one section encasing the shoulder, and the other the pelvis. When the desired position of rotation is obtained both for the shoulder and the pelvic girdle, the two sections of the cast are then united by plaster of Paris. As the writer had occasion to satisfy himself, when this method was demonstrated, the patient experiences very little suffering during this procedure, and his physical condition, especially his pulse and respiration, remains good.

The results of the method were most courteously demonstrated on patients as well as by lantern slides. While there has been no true over-correction of the curve in the anatomical sense, the cosmetic effect of the method has been, to say the least, striking. The fenestration of the cast is very much the same as in Abbott's method. Two or three casts are applied at intervals of one month, the total average time of fixation being about four months. Felt pads are inserted over the costal prominence, in the back, and in front, through windows, as in the Abbott method. The particular advantage of this method seems to the writer to lie in the more accurate plaster technique, in the more efficient rotation of both pelvic and shoulder girdle by means of the special apparatus, and, lastly, in the much greater degree of comfort which the patient enjoys.

Following the plaster of Paris period, a celluloid brace is worn for half a year, and vigorous scoliosis exercises are begun at once. The latter are extended for a period of from one to two years.

The material of Prof. Galeazzi amounts to about 100 cases a year.

BOLOGNA.

The Istituto Ortopedico Rizzoli.

Francesco Rizzoli was one of the most famous professors of surgery of the University of Bologna. The Istituto Rizzoli owes its existence to the noble generosity of this man, who donated his entire fortune to the creation of a great orthopaedic institute to be located in the old monastery of the Olivetan monks. In 1880, he bought the site of the present hospital with the old monastery situated on top of the most picturesque of a chain of hills south of the city, called San Michele in Bosco.

At the expense of one and one-half million lire and by an effort of fifteen years, this magnificent old historical structure was finally adapted for its new purpose. The first director of the institution was Panzeri, who at the same time filled the directorship of the orthopaedic institute at Milan. But it was under Alessandro Codivilla, the father of modern orthopaedic surgery in Italy, that the Institute rose to the highest scientific level, which it has maintained undisputably to the present day. After a short administration under Cesaro Ghillini, the Institute is now finally in the hands of that most brilliant and ingenious of all living orthopaedic surgeons in Italy, Vittorio Putti.

In adapting the building for its present use, the needs of a modern and scientific institution have been most happily harmonized with the aim of preserving the old historical charm and beauty of the building. Situated upon a hill and within short distance from the city, it commands an incomparable view over one of the most beautiful cities of Northern Italy.

The building encloses two great courts laid out in Italian style, one of them being named after its founder. The long porticos facing the courts as well as the front of the building, lead to rooms and halls of dimensions quite unknown to our American plan of hospital construction. One of the halls is 160 meters long, and may be closed in with glass during the colder season. As the latest concession to modern hospital equipment, Prof. Putti tells me that he has introduced the American fly-screened windows.

The rooms for the patients are large, light, and airy. There is an orthopaedic gymnasium, most excellently equipped with Zander machines and other apparatus. The abundance and variety of this equipment the writer has not seen equalled in any other institution. In the scoliosis rooms, one may find one of the very few Schulthess scoliosometers in existence, together with other original Schulthess machines.

The old refectory of the monks houses the pathological museum, which contains many interesting specimens of bone pathology, beautifully arranged in glass cases.

The library of the Institute, which is essentially an orthopaedic library, contains a very large number of volumes, and among these, some very valuable antique editions. All modern orthopaedic journals and most of the leading medical journals in general are represented. A special librarian is employed whose duties are not only the ordinary duties of a library custodian, but who also, I understand, is capable of lending a helping hand in the extensive literary work which is always carried on in this institution. Professor Putti's activities as editor of the leading orthopaedic journal of Europe are such that the efficiency of an orthopaedic library must be put to a rigid test.

THE SHOPS.

The orthopaedic shops of the Istituto Rizzoli are the largest and the most completely equipped of any which the writer has had occasion to see. These shops are contained in four very large sheds, and it is stated that more than 100 workers, most of them skilled mechanics, are employed. A technical director is in charge of the technical work, and he is assisted by a commercial director who takes care of the distribution and sale of the products of this shop, which serves not only the needs of the institution but which sends out its equipment and artificial limbs over the entire kingdom. The work is divided into a department for artificial limbs, one for brace work, one for the manufacture of instruments and tables, each one of these divisions being housed in a separate building. Among the many new instruments, the writer admired especially the new table of Putti. This is a most ingenious piece of machinery, extremely suitable for the application of all kinds of plaster of Paris casts. The exactness of its construction and the versatility of the use of this table places it above any others I have seen. As regards the artificial limb work, the profession is well acquainted with the newer constructions, especially the splendid types of upper extremity prosthesis which have been developed by Putti, Delitala, and other Italian orthopaedic surgeons. One may see them here in all stages of evolution, and one cannot help but be impressed with the precision of the work which penetrates every detail. A good deal of use is made of celluloid braces which are manufactured with, one might say, an artistic finish; especially celluloid torsos and body braces of different types seem to be very generally in use. In the special division devoted to orthopaedic instruments, the writer's interest was engaged by Putti's

osteotone, an instrument which he described some time ago in connection with the technique of lengthening shortened bones. To this group of instruments belong also the so-called osteo-synthetic outfit and his chisels and files used for arthroplasty.

A whole afternoon spent in inspecting the diverse activities of this shop work seemed none too long a time and a very well paid effort, in view of the many new and interesting things that could be learned.

It has been the writer's good fortune to see Professor Putti operate on a number of interesting cases.

An arthroplasty of the elbow was done on a woman of 23 for ankylosis of this joint following gonorrhea. A semi-curved incision was used, starting laterally and encircling half the elbow, somewhat similar to the incision used by Ashhurst. A great deal of care and precision is given to the dissection and the modelation of the bone, more resecting being done from the end of the ulna than from the humerus. The head of the radius was also carefully freed and stripped of its attachments. After shaping the bones, they are carefully filed and smoothed, and a strip of fascia lata taken from the thigh of the same side is used to cover the head of the humerus as well as the head of the radius. The sutures are especially carefully carried out. The plaster of Paris cast which is subsequently applied fixes the limb in acute flexion and semi-pronation.

A child of six was operated upon on the right foot for paralytic equino-valgus deformity. Here the method of tendon sheath exchange was used. Through an anterior incision in front of the tibia, the extensor communis and tibialis anticus were isolated. Through a second incision made over the metatarsus, the extensor communis was divided over the middle of the metatarsal bones, and the peripheral ends were sutured to the extensor digitorum brevis. Then the central portion of the extensor communis longus was led out through the anterior incision in front of the tibia. Then the sheath of the tibialis anticus was opened and through this opening a guide was passed downward and carried out through a third incision made over the insertion of the tibialis anticus. Through this guide a double catgut suture was now passed upward, the tendon was attached to its sling, and finally it was led out through the incision over the tibialis insertion where the tendon of the extensor communis was finally fastened. In conclusion, the plastic lengthening of the tendon of Achilles was performed and all incisions were closed. Although the operation required four incisions, only 20 minutes were consumed in its completion.

The same patient was operated upon on the other leg for calcaneo-valgus deformity, and here a method entirely new to the writer was

applied. Through an anterior incision, both astragalus and tibia were laid bare. Then, with the motor saw, a quadrangular piece of the tibia one and one-half inches long and about one-fourth of an inch wide was resected. Next the chisel was driven horizontally into the body of the astragalus, making a cleft which was pried open wide enough to receive the resected piece of the tibial graft. This raised the anterior portion of the body in such a way as to inhibit dorsal flexion of the foot. The check on the dorsiflexion immediately after the operation was extremely complete.

For the relief of contracted hip in infantile paralysis, myotomy was undertaken from an incision similar to that of Smith-Petersen. In addition to the stripping and section of the contracted structure as it is done in Soutter's operation, Putti proceeds to the exposure of the contracted anterior capsule, which he believes is very often inhibiting the complete extension. An operation for traumatic saddle-nose was performed with consummate skill, although it was a rather simple procedure, consisting merely in the insertion of a previously made ivory prosthesis. The cosmetic effect of this operation, which took hardly more than 10 or 15 minutes, was striking.

Among a number of cases demonstrated after operation, the writer remembers especially two cases of arthroplasty of the knee which were additional to those already demonstrated by Putti in 1921. The first of these two cases was a man who had received a gunshot wound in the knee resulting in complete ankylosis. It was then three and one-half years after his arthroplasty. The second patient whose knee had likewise become ankylosed, following gunshot wound, was 9 months after the arthroplasty. Both patients showed a range of motion of 70 degrees, absolute lateral stability of the knee; in one case there was complete, and in the other almost complete active extension. Both patients walked perfectly.

It was also of interest to note the large number of cases of congenital dislocation of the hip which are operated upon in this institution. While this deformity is almost unknown among the southern Italian races, it is very frequent in northern Italy. So far as I am able to learn, the treatment is quite uniform in the different Italian orthopaedic clinics. The matter of reduction is the bloodless method of Paci. The postoperative fixation averages only 4 to 5 months, during which time two or three plaster casts are used. When the last cast is removed, fifteen days of rest in bed are allowed, during which time the hip is held immovable by sandbags. The casts are applied with the hip in

inward rotation in the majority of cases. After the period of bed rest, walking is allowed and massage is begun.

The treatment of scoliosis is based mainly upon corrective casts applied in extension and followed by scoliosis gymnastics, for which the splendidly equipped gymnasium offers ideal facilities. It has been the writer's great regret that the short time of his stay would not permit him to study all the different methods applied in this institution, but whatever he has had the good fortune to witness was certainly of the highest scientific and technical attainment.

VIENNA.

Institute Exner.

It is the merit of W. Exner in Vienna to have been the first who consolidated a group of engineers and physicians for the purpose of constructing prostheses and of standardizing the parts. He founded the association called "The Technique for War Wounded," and under its auspices an orthopaedic laboratory for the manufacture of prostheses is conducted. It was founded during the war in 1916.

In its present form the institution has become more or less independent of the big orthopaedic hospital in Vienna, which is directed by Spitzy. The institution is producing only a limited number of prostheses but the work is carried out with the utmost technical precision and the most accurate tests are constantly made as to the value of the materials and durability, and all technical details are thoroughly investigated. This institution is, therefore, not merely a workshop for the manufacture of prostheses but it is also a technical research station and the work is markedly superior to that seen in commercial shops.

The Vienna Orthopaedic Hospital is under the direction of Prof. Hans Spitzy. It is housed in a new five story building, constructed during the war, and it is said that it contains four hundred patients, a larger number than any other orthopaedic institution on the continent. The operative side of the orthopaedic work is highly developed. The work shop excels especially in the manufacture of prostheses, a whole wing of the institution being given over to that work. The orthopaedic shop is under the medical supervision of Dr. Felix Bauer and through his courtesy the writer was able to become familiar with the details of the work.

The Clinic of Lorenz has been considerably enlarged of late, the number of beds now amounting to about 40 or 50, including a barrack for children and a second barrack for the mechano-therapy of ambula-

tory patients. Dr. Julius Hass, who is first assistant, is a man of unusual attainments and a decided scientific bent, and the writer would not hesitate to count him as the best of the younger orthopaedic surgeons of Vienna.

A good deal of interest is being aroused by a new operation upon the femur called bifurcation, and applied in cases of old irreducible dislocated hips or in cases of non-united fractures. The method is essentially that of an oblique osteotomy, in which the point of the lower fragment is placed against the empty socket in such a manner that a sort of bifurcation results, with the head forming the upper, and the point of the neck the lower branch of the fork, the neck being implanted into the acetabulum.

From what I have seen and heard of patients who have had this operation performed, the functional results seem to be very good.

Of special interest is also the large collection of x-ray plates, especially those of bone degeneration and changes in general brought about by the low nutritional conditions. Numerous cases of hunger psathyrosis, and an endless number of severest types of rickets with spontaneous fractures or infractions of the bone are contained in the collection of Dr. Hass.

REPORT OF THE COMMISSION APPOINTED BY THE AMERICAN ORTHOPEDIC ASSOCIATION FOR THE STUDY OF STABILIZING OPERATIONS ON THE FOOT.

MAY, 1922.

To review briefly our work of last year: the Commission visited clinics prepared for them in the cities of Cleveland, Chicago, Milwaukee, Boston, New York, and Philadelphia; witnessed operations and personally examined the feet of some two hundred and fifty patients.

The Commission found that a flail foot—a foot in which the muscles were so completely paralyzed as to be unable to control the motions of the joints, an unserviceable foot, often painful, could be converted by certain surgical procedures resulting in ankylosis of the joints into a serviceable, painless foot: not a perfect foot perhaps, but a foot that the patient could use, one that he could depend on to carry him without discomfort through all the ordinary activities of his daily life.

Should the ankylosis take place with the foot in the position of even slight calcaneus the patient will be a heel walker and he will always limp. A heel walker, who bears little or no weight on the ball of the foot, will always limp, because the arc of the circle or rocker which the sole of the foot forms when in the act of walking over a flat surface is shorter on the side on which only the heel is used. This is equivalent to moving the fulcrum of the lever from two to three inches backward, thus displacing the center of gravity, shortening the time in which the foot rests on the ground, and causing an inequality in the gait.

The Commission holds that even this is a good operation because the patient is infinitely better off than he was before the operation. However, there is no good reason why the ankylosis should be allowed to take place while the foot is in the position of calcaneus, as it is perfectly practicable at the time of the operation to place the foot in the position of moderate equinus. The patient would then be able to use his whole foot, both heel and ball, in walking. This would give him a great advantage over the heel walker and would greatly diminish, if it did not entirely obviate, the limp. Furthermore, the raising of the heel would have the practical effect of lengthening, to a certain extent, the shortened leg and this would be an additional advantage.

Still even this, good as it undoubtedly is, is not the best result that can be attained.

An ankylosed foot is rigid and a rigid foot is not as serviceable as a foot with a limited amount of useful ankle motion.

A new and simplified ankle-joint can be made and the motions of this joint controlled by bone balance, independent of muscular action, by either the transverse horizontal section of Davis, in which no bone is removed, the open operation preferred by Hibbs and others, in which superfluous bone is removed, or astragalectomy after the method of Whitman, which consists of the removal of the astragalus and the displacement of the foot backward on the tibia and fibula. The result of the first two operations is an ankylosis of the tarsal bones and a displacement of the foot backward on what is left of the astragalus.

It is absolutely essential for the success of these operations that the foot be actually displaced backward and it is desirable that the foot be placed in the position of moderate equinus. In contrasting these operations, all of which, when properly performed on suitable subjects, give excellent results, the Commission prefers first, the astragalectomy of Whitman; second, the open operation advocated by Hibbs, and third, the transverse horizontal section of Davis.

In regard to the selection of cases, the Commission is convinced that patients having paralytic talipes calcaneus, talipes calcaneocavus, and flail or dangle foot, with or without the additional deformities of varus or valgus, are suitable subjects for the operations of astragalectomy and transverse horizontal section, and that patients having active calf muscles are *not* suitable subjects for these operations.

There is also a not uncommon class of cases which resemble equinus or cavus. These, however, have a rigid heel cord and on examination the astragalus and os calcis are found to be in nearly normal position, and the whole drop confined to the anterior portion of the foot. Should a foot of this type be mistaken for a case of talipes equinus and the heel cord subcutaneously divided, the result would be a surgical disaster, for the pseudo talipes equinus would be converted into a very real talipes calcaneocavus. The best method to remedy this deformity is to leave the heel and heel cord in their present position and to cut a sufficiently large wedge of bone from the dorsum of the foot to allow the anterior or dropped foot to be brought back to its proper position. The wedge of bone that has been removed contains the greater part of the head of the astragalus and the posterior articulating surface of the scaphoid, and the resulting ankylosis or union of these bones may be depended on to hold the foot in its proper position. The result is a stable foot, a little shortened, but with good ankle and lateral motion and under muscular control.

A wedge of bone with resulting ankylosis, or with the addition of more or less complete ankylosis of the bones of the tarsus, will correct such malformations or deformities of the bones as are commonly found in varus or valgus, or the same deformity may be corrected by removing superfluous portions of bone when the various joints of the tarsus are prepared separately for arthrodesis.

The Commission holds that although a faulty muscle balance was the first cause of the development of the deformity, yet the correction of a faulty bone balance must be the first step towards a cure.

The Commission fully realizes that none of these operations can be called curative in the sense that the case is definitely cured when the cast is removed and the wound healed. Unequal muscle balance will distort a growing foot and it is not always possible to predict with certainty the actual strength of a partially paralyzed muscle or transplanted tendon. Careless shoeing may also lead to disturbance of balance with consequent deformity.

All of these patients should be kept under occasional observation, if possible, until they have obtained their full growth.

It is important to maintain a muscle balance, and such tenotomies and tendon transplantations as may be obviously necessary can usually be done at the time the bone balance is corrected.

But, assuming that all of our patients' bones are of normal shape, what can be done with the muscles alone? Of the two hundred and fifty feet that the Commission examined last year, all, at one time, had bones of normal shape, the great majority had had tenotomies and tendon transplantations galore and yet all had come in the end to a bone-cutting stabilizing operation. The Commission naturally asked itself the question, is tendon transplantation really of any practical use except as supplementary to a bone-cutting stabilizing operation? Why not do, in the first place, the obvious practical thing that you will be ultimately forced to do?

But this is an unfair conclusion because we had seen only the cases that tendon transplantation had failed to relieve. Therefore, realizing that our report was still incomplete, the work this year of the Commission on Stabilizing Operations upon the Foot has been extended, by order of the President and the Executive Committee, to a study of the problem of partial and total paralysis of the dorsiflexors of the foot.

To this end clinics in Iowa City, Kansas City, Chicago, Cleveland, New York, and Hartford were visited by members of the Commission.

The problem presented this year to the Commission on Stabilization of Paralytic Feet, therefore, concerns the best method of treating the

drop-foot. By this, we understand, is meant the foot which has no power of dorsiflexion, and to which no such power can be supplied by tendon transplantation, and furthermore in which no tendency to lateral deviation or deformity exists. Several different methods of alleviating the condition have been considered in this study: 1—Arthrodesis of the ankle-joint by excision or by graft; 2—Silk ligament suspension; 3—Gallie's, Putti's, and Codivilla's methods of suspending the foot by fastening the tibialis anticus and peroneus tertius to the tibia; 4—The suspension of the foot by strips of fascia lata or the fascia of the leg; 5—The diamond-shaped excision of skin or bone flap from the front of the ankle and tarsus; 6—Astragalectomy; 7—By the use of braces or elastic bands.

1. Arthrodesis of the ankle-joint, by the usual method of excising the opposing articular surfaces of tibia, fibula, and astragalus. The operation usually fails to produce ankylosis if performed under the age of 14. It is advisable to fracture the external malleolus and displace it inward so that the three bones can be closely approximated, as otherwise the union is insecure. Most of the patients examined were dissatisfied with the result, although the feet were unquestionably stabilized. The chief complaint was of the increased strain thrown upon the medio-tarsal joint, and the difficulty in walking up hill and down hill, and in putting on and taking off the shoes. The latter difficulty is easily remedied by having the shoes laced down to the toes. The operation has fallen into disfavor, and is apparently very rarely performed in this country. The method originated by Lexer, of attempting arthrodesis by driving an autogenous or heterogenous peg up through the os calcis and astragalus into the tibia, is basically unsound, because the intra-articular portion of the peg usually becomes absorbed within a year, and the result is a failure. (Steindler is now bringing forward a modification of Goldthwait's operation).

2. Silk ligament suspension, by passing heavy silk cords from the tarsus to the tibia, has been done in a fairly large number of cases. In very young children it is not to be advised, since, on the one hand, the silk is apt to cut through the bones of the tarsus, and, on the other hand, with the growth of the foot and leg the unyielding cords cause severe distortion and disability. In one case the foot was pointed upward at an angle of 25° from the horizontal, and it was necessary to lengthen the strong band of silk and surrounding tissue by operation. It is only fair to state, however, that in cases operated upon in early adult life the results are sometimes excellent; one patient was examined whose foot had been efficiently and satisfactorily held for

twelve years by silk ligaments. In some of the other cases the drop-foot had been controlled perfectly, but lateral distortion, either varus or valgus, had gradually occurred, as is seen so often after tendon transplantations and even after astragalectomy. In a few cases the silk had caused suppuration, sometimes months or years after operation. In the opinion of the Commission, the use of silk ligaments should be restricted to an occasional carefully selected case not under 15 years of age.

3. Tenodesis, or the fastening of tendons to the tibia (and fibula) by the method of Putti, Gallie, or Codivilla. This type of operation can be used in younger cases than the silk ligaments, since the attached tendons are likely to grow at approximately the same rate as the foot and leg. Gallie's technique has been carried out in a large number of cases, and while it has been successful in preventing lateral deformity and calcaneus in a very reasonable way, nevertheless, as a means of controlling drop-foot the results have by no means been universally satisfactory. In some instances, without a doubt, the technique has not been properly interpreted. The tendons must be carefully stripped and denuded, and even scarified, to ensure their adhesion to the bone; all strain and tension on the tendon must be neutralized; the time of immobilization must be long. And then, after union is complete, there is still considerable uncertainty as to whether or not the tendons, paralyzed and none too strong, will have sufficient strength to stand the continuous strain and drag of a lifetime of use. The Commission feels that there is a distinct field for this type of operation, and would have liked to see many more cases which had been operated upon years ago.

4. Suspension of the foot by strips of fascia lata or the fascia of the leg. Very few examples of this operation have been seen, and the results have not convinced us that it is to be advised. It is believed that strong strips of fascia lata could be successfully employed, in the same way that they have been used in reconstructing the lateral ligaments of the knee, but it is felt that sufficient time has not yet elapsed to demonstrate the permanency of the fascia lata.

5. The excision of diamond-shaped pieces of skin or a skin-bone flap made from the front of the ankle-joint, the incision being sutured so as to hold up the foot, is of temporary benefit only, since the remaining skin soon stretches and allows the foot again to drop, or the bone fractures, and then the skin stretches.

6. Astragalectomy.—This operation unquestionably limits the range of motion at the ankle, and although it was originally developed by Whitman to relieve the opposite condition (calcaneus or cavus), it

has a distinctly beneficial effect in drop-foot, especially where the foot is entirely flail. A few cases have been examined in which very free motion subsequently developed in the medio-tarsal and anterior joints, but the results as a rule have been sufficiently good to warrant its use in selected cases.

It will be seen, therefore, that the Commission does not feel convinced that any of the operative methods here considered can be confidently recommended as a standard procedure. We would further state that the lateral deformities of paralytic feet are far more disabling than drop-foot, and that they require operation in a far higher percentage of cases than does simple drop-foot.

7. It was found that several types of drop-foot braces were cheerfully and comfortably worn by both children and adults, whereas braces used to control the other varieties of foot deformities are not well tolerated. The plain elastic straps fastened to the shoe, the spring-wire supports with a coil at the sides of the heel, and the flat spring bent to fit under the sole and up the back of the leg are all useful and agreeable.

The Commission would urge that tendon-transplantation be almost universally supplemented by stabilization of enough of the smaller joints of the foot to prevent or correct all tendency to varus or valgus deformity, since the examination of a large number of post-operative cases has shown that the lateral deformities are of much greater importance than drop-foot.

(Signed)

ANSEL G. COOK, M.D.,
WALTER G. STERN, M.D.,
EDWIN W. RYERSON, M.D.

Current Orthopaedic Literature

TUBERCULOSIS.

TUBERCULOSIS IN CHILDREN FROM THE STANDPOINT OF THE SURGEON. Lloyd T Brown. *Boston Medical and Surgical Journal*, September 28, 1922.

This monograph discusses briefly the minor part which surgery plays in the eradication of non-pulmonary tuberculosis. Statistics and cases are presented as evidence of the advantages of rest and fixation.

Surgical immobilization alone of the spine is impossible. Supports should be used as long as the lesion is progressive. Recumbency is the best method of treatment. Surgical immobilization of the spine gives best results in adults if the operation is followed by recumbency for six months. Dr. Brown advocates recumbency for two or three years in the treatment of tuberculous caries of the spine.

The safe rule is—absolute fixation and constant immobilization of the spine in recumbency until resolution is established and the spine, with the aid of support, is capable of bearing weight without yielding. The period of recumbency must be determined by x-ray study and the general condition.—*William Jackson Merrill, M.D., Philadelphia, Pa.*

TUBERCULOSIS OF THE HIP. R. Franklin Buzby. *N. Y. Med. Jour. and Med. Record*, Aug. 2, 1922, p. 150.

A paper dealing with the pathology, symptoms, diagnosis, prognosis, and treatment of tuberculosis of the hip, special attention being paid to careful and long fixation of the joint. The generally accepted ideas of treatment are used.—*Edward S. Hatch, M.D., New Orleans.*

TUBERCULOSIS IN CHILDREN FROM THE STANDPOINT OF THE ORTHOPAEDIST. Joel E. Goldthwait. *Boston Medical and Surgical Journal*, September 28, 1922.

In the treatment of tuberculosis in children, Dr. Goldthwait lays special stress on the improvement of the child's general condition, proper posture, and correct use of the diaphragm, to increase the child's resistance to tuberculosis, as well as to other infections.

He advocates the prevention and correction of deformity during the course of, and after the subsidence of the disease, as indicated. He states, "as fast as the child is able to use the part, it is to be encouraged."

This is not safe in many cases, for many children will use the affected part when the course of the disease is progressive, before the diseased part is ready for functional stimulation, in which cases too early function prolongs the convalescence, increases the pathological area, and tends to produce greater deformity.

Frequent x-rays to determine the local progress of the disease, and the trend of the general condition must determine the time when function should commence.—*William Jackson Merrill, M.D., Philadelphia, Pa.*

DIFFERENTIAL DIAGNOSIS OF INCIPIENT TUBERCULOUS SPONDYLITIS AND CHRONIC RHEUMATISM OF THE BACK. P. Pitzen. *Münch. med. Woch.*, June 9, 1922.

Diagnosis of the beginning spondylitis is more difficult in adults than in children. The disease develops more slowly and the disturbance in the general condition is less. Loss of motion is less noticeable and the gibbosity appears later. Then also, other diseases cause pain in the back in adults, as, for instance, muscular rheumatism. Schede, Lange, and Eversbusch established that chronic muscular rheumatism causes "myogelosis." Pronounced hardness of the muscle, *i.e.*, "myogelosis," is sought for thus: The patient must be placed so that the musculature to be examined is relaxed. The examining fingers and the skin of the patient are greased. Then the muscles in the region of the pain are stroked crosswise to the direction of the muscle fibres, by the greased fingers, while the other hand fixes the muscle. The pressure must be firm enough to feel the muscle definitely. While healthy muscle is generally soft, the "myogelosis" feels like firm cords and painful on pressure. As a control, the same muscle on the other side can be examined likewise, or if that is diseased also, longitudinal strokes can be made on the diseased muscle. There then is felt at the same spot cords of different length which are differentiated by their consistency from the other muscular fibrils. If "myogelosis" is established, the diagnosis of chronic muscular rheumatism is almost certain but still spondylitis cannot be excluded, as there can be muscular hardness as a result of the strain of the musculature with tuberculosis of the vertebrae. With spondylitis, the pain is in the middle of the back or radiating to the trunk and extremities, and is influenced by the motions in the sagittal plane and is increased by tapping of the spinous processes of the diseased vertebrae or by jamming the vertebrae. With chronic muscular rheumatism, however, there is pain on one or both sides of the spinous processes in the musculature adjoining. Cautious motions and jamming of the vertebrae or tapping of the spinous processes have equally little effect. Motions of the vertebrae are completely lost in spondylitis, but limited with muscular rheumatism.—*Armin Klein, Boston.*

OPERATIVE VERTEBRAL SYNOSTOSIS AS A TREATMENT FOR POTT'S DISEASE. Radulesco. *Revue d'Orthopédie*, July, 1922, p. 305.

In 1886 Wilkins attempted internal fixation of a tubercular spine by fastening the spinous processes together with metallic sutures. Hadra, in 1891, proposed tying the spine together with silver wire after forcibly correcting the kyphos as much as possible. This was tried by Chipault, but the wire cut through the bone and the deformity recurred. Vulpius, Lange, Church, and

Whitman, also proposed and tried various means of producing ankylosis of the spine. Albee, however, deserves great credit for developing a successful method for this purpose. Hibbs, Tuffier, Dujarier, Calvé and Galland have also devised methods which, except for that of Hibbs, are more or less similar to Albee's technique.

Radulesco describes a method which he has employed. He splits the spinous processes carefully into sagittal halves, after freeing them from each other by cutting the interspinous ligaments. These halves are then turned down laterally so that they lie flat, just like opening up a book, with the raw bone surface spread out. A graft is then removed from the rib, usually the eighth or ninth. This graft comprises only half the thickness of the rib, with spongy bone on one side and solid cortex on the other. It is placed flat on the prepared surface in the spine, spongy side next to the raw surface and is held in position by suturing the aponeurosis and muscles over it with strong catgut. For adults and older children he uses spinal anesthesia because the patient can lie quietly in the ventral position after the operation without the disturbance which follows general anesthesia. This ventral position is maintained for six or seven weeks, then the patient is turned on his back for a month longer. Most of the patients leave the hospital without any supporting apparatus.

In judging the value of the open operation there are many factors to be considered. The author's cases were almost all done at a seaside sanatorium where conditions were much more propitious than in the large cities. The method of operating and the skill of the surgeon influence the results. Of 250 cases done by Albee there was no mortality, while among 288 operations by various surgeons there occurred 12 deaths. Vulpius reports 30 cases with excellent results in all. Hans Thomsen published 17 cases with four deaths and poor results in the others. Clairmont obtained a cure of paresthesia in a man of 20 by the Albee method. Many other authors are cited with various results, but on the whole favorable to the ankylosing operation. Almost all these observations are by continental surgeons. It is the opinion of many of them that the operation is not a substitute for the classical methods of treatment but only an adjuvant procedure. Calvé regards it as contraindicated in young children.

As to methods, the author has rejected the Albee technique because it is more difficult than others, because the tibial graft has to be cut and bent to fit the kyphos, thereby causing weakness, and because the spinous processes are too narrow to furnish a good grafting surface by this method. The Hibbs operation is ingenious in appearance, but most surgeons get bad results with it. The procedure of Calvé and Galland, which involves resection of the entire spinous processes and arthrodesis of the intervertebral joints, while logical, is too complicated and attended by too much shock. By his own method Radulesco claims to obtain a larger and more solid callus than by other methods. Also, the graft from a rib is always curved to fit the kyphos and is easily bent; it leaves practically no defect in the rib and is more accessible than the tibia. Twenty-five cases have been treated by him and his associates according to this method. Most of the cases chosen for operation had abscesses, paraplegia or tubercular lesion of other organs. These were chosen designedly to test the value of the method. Some who had been in bed months, or even years, recovered movement and were able to walk without support in two or three months after

the operation. The results in general have been good and no deaths occurred. One patient developed tubercular peritonitis four months after leaving the hospital, one had a cold abscess and sinus form at the site of operation without elimination of the graft. In another case the graft came out because of suppuration, but a callus formed, nevertheless, and the result was as good as the other cases.—*William Arthur Clark, Pasadena.*

CONGENITAL DEFECTS AND CONGENITAL DISLOCATIONS.

LATE RESULTS OF MANIPULATIVE TREATMENT OF CONGENITAL DISLOCATIONS OF HIP. E. L. Evans. *Brit. Journ. of Surgery*, July, 1922.

Evans' personal experience relates to 49 cases of congenital dislocation of the hip, involving 61 joints, treated between the years 1903 and 1916 inclusive. Of these he is enabled to give the late results in 31 cases, involving 38 joints.

He groups his results as follows:

Groups.	No. of cases.	Percent.	Average age.
1. Concentric reduction with normal head and neck	10.	26.	4.1
2. Concentric reduction with changes in head and neck	13.	34.	5.1
3. Excentric nearthrosis	5.	13.	4.5
4. Anterior transpositions	4.	10.5	4.8
5. Posterior dislocations	1.	2.5	6.5
6. Loss of head and neck	1.	2.5	2.9
7. Unreduced dislocations	4.	10.5	6.75
Total cases	38.		

X-ray illustrations of the results are given and show the usual deformities of head and neck to be encountered in such a series as we see them in America. He has had one loss of a head and one fracture. The method of reduction was based upon Lorenz's manipulation, though with increasing gentleness with increased experience. The limbs were put up in plaster flexed 90 degrees and abducted 70 degrees, the double cases kept up from three to six months, the single ones from eighteen months to two years.—*Charles A. Parker, Chicago.*

LATE RESULTS OF TREATMENT OF CONGENITAL DISLOCATIONS OF HIP. H. A. T. Fairbank. *Brit. Jour of Surgery*, July, 1922.

Fairbank bases his conclusions upon 146 personal cases in which 175 hips were treated.

He follows the Lorenz method of reduction, though avoiding the rougher means that Lorenz originally used. Thirteen cases were treated by the open method and the results shown in a separate grouping.

His late results are given in 112 cases that were followed for at least five years.

The following table records his results:

Unilateral Age	cures, percent.	Anterior repositions, per cent.
Under 3 years	70.	15.
3, 4, 5 years	40.9	27.2
6 and over	28.5	33.3
All ages	46.	25.3

Bilateral Age	cures, percent.	Anterior repositions, per cent.
Under 3 years	46.6	33.3
3, 4, 5 years	22.7	18.
6 and over	33.3	25.
All ages	32.6	24.4

He commences treatment as early as 18 months in the absence of indications for delay. His oldest patient was 14 years, an unsuccessful case.

Among the complications there were five fractures. Changes resembling osteochondritis deformans juvenilis occurred in 7 cases. Arthritis with stiffness of the hips developed in six cases under treatment, the symptoms varying in duration from a few weeks to 18 months, but in every case subsiding with rest.

One hip ankylosed through infection from suppurative hæmatomas in the adductors.

Of the 13 operated cases no late results could be obtained, although all but two were reduced by the operator. A third hip was so unstable after reduction that an attempt at cure was abandoned and in one case infection occurred with ankylosis in position above the acetabulum.

His deductions are as follows:

1. If treated sufficiently early an anatomical cure by manipulation should be obtained in 75 per cent. of the unilateral and 50 per cent. in the bilateral cases.

2. Additional attempts should be made in the unsuccessful cases followed in two or three weeks by an open operation whose purpose is to make an upper lip to the acetabulum without opening the joint, a comparatively safe procedure, he considers.

3. Open reduction should be used only in refractory cases in infants and in selected cases over 6 years of age.

4. Full right angled abduction should be maintained for a minimum of six months.

5. He hesitates to attribute to the anterior repositions any advantage over untreated cases as far as late results with arthritis are concerned.

6. Physical treatment after removal of cast probably has no effect on anatomical results.—*Charles A. Parker, Chicago.*

SOME CONSIDERATIONS ON DORSALIZATION OF THE SEVENTH CERVICAL VERTEBRA.

Fouilloud-Buyat. *Revue d'Orthopédie*, July, 1922. Page 333.

The author reports, as follows, a case of cervical ribs:

Woman of 25 developed pain and swelling in the right arm and formication in the right hand without obvious cause. These symptoms were exaggerated if the arm hung down or if she carried anything heavy. Fingers were somewhat swollen but cold. Medication was of no avail and the pain steadily increased, radiating to the base of the neck and the occipital region. A diagnosis of cervical Pott's disease was made and a cast applied, but without relief. Seven months after the onset of the pain in right arm the same set of symptoms developed in the left arm.

Examination showed normal movements in the cervical spine, but tenderness on pressure over the third to seventh cervical ribs. Tenderness also on pressure about 2 cm. behind the clavicle, but nothing objective found there. The muscles of the shoulders and arms were slightly tender. Otherwise the examination was negative. The possibility of Pott's disease was rejected and a diagnosis of cervical ribs was made and confirmed by roentgenogram. They were bilateral with head, neck and tuberosity similar to normal ribs. The transverse processes of the seventh cervical were enlarged.

Surgical treatment was refused and the patient's condition remains about the same.

In the symptom-complex produced by cervical ribs the nervous phenomena usually predominate. Bilateral pain is very rare, even in cases of evident bilateral lesions. Vedova reported 14 cases with the malformation on both sides, but symptoms only on one side. In the above case the anomaly comprised two elements: the cervical ribs and the hypertrophied transverse processes of the seventh cervical. These processes were not only unusually large, but were directed upward more than normally. This part of the deformity may exist independently. A case is cited in which the symptoms were typical of cervical rib, but only an enlarged transverse process was found by roentgenogram. In these cases the seventh cervical conforms more to the dorsal type than to the cervical.

We are by no means certain regarding the mechanism which produces the symptoms in these anomalies. Some cases are completely cured by removal of the supernumerary rib, others are only improved temporarily, others are not relieved at all. Why this difference in results? Are the symptoms due to compression or must we look for some other explanation? Oppenheim has said that there may be a malformation of the soft parts of the spinal cord coverings concomitant with the bony malformation, just as is encountered in spina bifida. It seems logical to admit that instead of a cervical rib producing a dystrophic influence on the spinal cord, a malformation of the medullary structures, itself of little importance, manifests itself objectively in a developmental trouble of the vertebra. Symptoms such as tachycardia, hoarseness, and ocular troubles seem easily explained by pressure on the cervical sympathetic ganglion, but may they not have their origin higher up where these sympathetic filaments

come out from the cord? These ideas should not be regarded as hypothetic, because cases of syringomyelia have been reported in which the symptoms were very similar to those of cervical ribs, but in which, of course, no bone lesion or abnormality was present.—*William Arthur Clark, Pasadena.*

Scapula Crackling Sounds. O. Heinemann. *Klin. Woch.*, April 15, 1922.

Author reports case of patient of twenty years with crackling sounds, unaccompanied by pain, on motions of the left arm in the horizontal plane above the shoulder level. He removed a round exostosis, the size of a pea, subperiosteally from the upper, inner angle of the scapula. There was a permanent disappearance of the noise, while function of the arm was unaffected. This exostosis is described by anatomists as the inconstant tubercle of Luschka. Why the quite frequent Luschka's tubercle causes scapula crackling sounds only in exceptional cases needs further explanation.—*Armin Klein, Boston.*

Pain Due to Os Tibiale Externus. S. Peltesohn. *Klin. Woch.*, April 15, 1922.

In the adolescent foot as a rule in the early twenties there occur painful occasions which are connected with the presence of the inconstant external os tibiale. When one finds in a young pes valgus (not planus) a strong spring of the navicular bone, which on pressure or spontaneously is painful, and if a foot distortion preceded, then there is apparently an external os tibiale present, and it can be diagnosed with almost a certainty, even before roentgen examination. These cases usually occur in young girls of strikingly large, slender joints, with a marked prominence of the navicular tuberosity. The removal of the pain with the external os tibiale is to be attained in newer cases by "supinating adhesive plaster bandages and individually built plates." In older cases the plates usually cure. Their fitting should be personally and thoroughly carried out by the orthopaedic surgeon. It is quite possible that the external os tibale disposes to the pes valgus during the years of growth.—*Armin Klein, Boston.*

The Production of Temporary Paralysis in the Treatment of Difficult Cases of Congenital Dislocation of the Hip-Joint. George Robertson. *Surg., Gyn., and Obstet.*, August, 1922.

In cases from five to seven years and over that age much difficulty may be encountered. To minimize this muscular difficulty author recommends that temporary paralysis of great adductor group be produced by ligature pressure of trunk of obturator nerve by open operation. Incision same as made for femoral hernia. Accessory obturator nerve when present may be divided at the same time "with medium pressure upon nerve by direct ligature and maintained from one and one-half to two hours will give a paralysis of six months' duration." Special method of applying the ligature to allow of its easy removal after skin has been sutured is described by author in drawings. Author considers this method in certain difficult and rather late cases. He also uses this same procedure of nerve ligature for securing good alignment in fracture of the long bones.—*Thomas Madden Foley, Washington, D. C.*

BONY FEATURES OF POSTERIOR CONGENITAL DISLOCATION OF THE SHOULDER. T. Wingate Todd. *Annals of Surgery*, July, 1922, p. 70.

This article is based upon a study of 730 skeletons. It is not a true dislocation, but rather an imperfect development of the posterior border of the glenoid. The humerus is still in contact with the glenoid. The head of the humerus is normal. The acromion process is slightly depressed. The clavicle and coracoid are normal.

There were three cases found in 730 skeletons. All occurred in white males.

There is nothing to indicate that this in any way interfered with the function of the joint. References are appended.—*F. G. Hodgson, Atlanta, Ga.*

FORMS OF ARTHRITIS.

OSTEOARTHRITIS: PRINCIPLES UNDERLYING ITS SURGICAL TREATMENT. A. G. T. Fisher. *Brit. Journ. of Surgery*, July, 1922.

The following footnote on the title page suggests the high character and extensive scope of this contribution:

"Embodying the Hunterian lecture delivered at the Royal College of Surgeons of England, and constituting an abstract of a preliminary report to the Medical Research Council, who have generously defrayed the expenses of the research."

The author has undertaken a very ambitious work embodying a study of the etiology, pathology, symptoms, and treatment of this veritable orthopædic scourge. It brings to mind the monumental work of Nichols and Richardson, of Boston, in 1910, although it is not so extensive.

Regarding the nutrition of the joint cartilage and its relation to osteoarthritis, he distinguishes the central or free surface of cartilage and the lateral or portion next to the synovial membrane, and of the two thus speaks: "At the edge the articular cartilage becomes markedly fibrillated, and merges into the fibrous tissue, beyond which it is furnished with capillaries, derived from the circulus, without there being any marked increase of cellularity accompanying the transition. In the thin synovial layer over the lateral articulating area lie capillaries derived from the circulus articuli vasculosus of William Hunter. This lateral part is therefore far better nourished than the central. This fact is of fundamental importance and, in my opinion, is the key to many of the phenomena of osteoarthritis; for my theory, as will be seen later, is that the central part of the articular cartilage responds to the cause of osteoarthritis by degeneration, whereas the lateral part proliferates, owing to its richer blood supply." Thus the burden of his story is that the central portion of the articular cartilage degenerates at the same time, or rather preceding the time of the proliferation of the marginal portion with its developing "chondro-osteophytes."

An increased vascularity is considered the regular picture in the active stage of the affection and arteriosclerotic changes are of late appearance and are not considered of etiologic importance.

He thus defines the condition: "Osteoarthritis does not constitute a disease *sui generis*, but rather the series of physiological or pathological changes that occur in a joint when it is subjected to prolonged or oft-repeated injury either mechanical or toxic, but of a moderate degree of intensity." As to bacterial or other toxic products he inclines to the view that they are mostly transported to the joints from distant infectious foci. Outside of various traumata, he blames the toxins for most of the trouble.

As a basis of treatment he italicizes the following:

"(1) Eradication, as far as possible, of any focus or foci of toxic absorption, including measures that prevent the formation or assist the elimination of systemic toxins. (2) The cessation, particularly in uni-articular cases and in the lower extremity, of pressure between diseased articular surfaces. (3) Local treatment to the joints themselves to stimulate defensive reaction of articular elements, and to prevent ankylosis. (4) Dietetic and medicinal treatment."

He recommends the usual measures to clean up foci of toxic absorption, and suggests plaster casts for relief of acute conditions of joints and the use of caliper splints to protect joints of the lower extremity. Early eradication of sources of toxins is stressed. He advises the surgical measures usually employed to overcome deformities and to obtain better positions for the partially or wholly ankylosed joints. Regarding diet he says: "Sufferers from osteoarthritis are so apt to lose weight from the constant exhausting pain, that it seems desirable that the diet should be generous, strengthening, and digestible, and yet not of such a nature as to favor intestinal putrefaction. He is not enthusiastic about medicine in the treatment.—*Charles A. Parker, Chicago.*

DIETETIC TREATMENT OF CHRONIC ARTHRITIS AND ITS RELATIONSHIP TO THE SUGAR TOLERANCE. A. Almon Fletcher, M.B. *Archives of Int. Med.*, July, 1922.

Fletcher presents a study of one hundred cases of arthritis in which the sugar tolerance was determined and in which the effect of reduction of diet alone was studied. The majority of patients were of the peri-articular type, with and without deformity. A few showed hypertrophic changes, and one or two showed both types. The study of these patients was well conducted and well controlled.

The sugar tolerance test of Hamman and Hirschman was used. The striking characteristic in the figures presented is the height, that is: lowered sugar tolerance, which many reached, and especially the delay in the return to normal. Three groups were selected—(1) those in which the average was less than 1.4; (2) those in which the average was from 1.4 to 2; and (3) those in which the average was greater than 2.

Many interesting points were brought out, a few of which might be mentioned. No relationship was found of the sugar tolerance to the severity of the disease. Women were found to have a lower tolerance than men. No sugar was found in the urine during the test.

The point was brought out also that the response to the reduction of diet in an arthritic is roughly proportionate to the reduction of the sugar tolerance, although there were occasional departures from this rule.

It would seem as though there were some evidence to suggest that a disturbance of the sugar tolerance is associated with infections. When various low

diets were being tried it was found that reduction of carbohydrates alone did not yield the best results, and the diet finally chosen was one low in calories but rich in vitamin contents. The author was of the opinion that the results of this diet appeared favorable enough to suggest the existence of an actual vitamin deficiency in arthritics. It was found, however, that the addition of the vitamins to the high caloric diet did not act as well as to a low caloric diet. The author feels that the reduction of protein in arthritics may do positive harm. His conclusions are as follows:

1. Of one hundred cases of chronic arthritis, reduction of diet alone appeared to result in the recovery of eight patients and in quite evident improvement in forty-three.

2. The sugar tolerance was decreased in the large majority of cases, and this decrease showed no relationship to the severity of the disease.

3. Patients who have a low tolerance are much more frequently benefited by reduction in diet than those cases with normal tolerance.

4. In certain cases of chronic arthritis, dietetic regulation appears to be the most effective form of treatment, and while the value of such treatment in an individual case cannot be determined with certainty, the lowering of the sugar tolerance is a useful clinical indication for this procedure.

5. Female patients derive greater benefit from such treatment than men, and, as a rule, they show a lower tolerance.—*M. S. Henderson, Rochester, Minn.*

Osteoarthritis of the Hip. George Parker. *British Medical Journal*, Sept. 23, 1922, p. 539.

A table of joint diseases prefaces this article, in which Group A is characterized by diseases showing little or no affection of the fibrous or synovial structures, but great bone and cartilaginous changes, as exemplified by osteoarthritis and gout. In the B groups septic causes are acknowledged. In B1 we find suppuration, as septic and tuberculous joints, in B2 there is no suppuration, but fibrous overgrowth and ankylosis, as exemplified by rheumatoid arthritis and gonococcal joints. B3, the last group in the writer's classification, leaves no permanent joint changes, as in true rheumatism.

The writer insists on the tendency of osteoarthritis of the hip to be essentially monarticular and of a distinctive character, though he admits that some authors disagree with him, considering that it may follow or precede similar changes in other joints. The symptoms are given in great detail: pain, tenderness, pseudo-locking attitude, muscular wasting, grating, and x-ray changes. Sometimes the hip presents the exact picture of an impacted fracture of the neck of the femur. It is noted that lameness and limited movement may exist long before bone changes are shown in the x-rays. Pathological changes are thinning of the cartilage at the centre of the joint, thickening at the periphery, with new bone formation and eburnation.

As regards etiology, J. Llewellyn is quoted as pointing out the influence of trauma to the hip. This may be acute, or may be chronic, due to knock-knee, flat-foot or a short leg. Mr. Strangeways, of the Cambridge Research Hospital, considers that thickening of the vessel walls may bring about changes in the

nutritive value of the synovial fluid, which under normal circumstances, he holds, is a source of nourishment to the articular cartilage. Altered nutritive value in this fluid leads to cartilaginous degeneration and fibrillation. There is no evidence of neural origin of the disease, and very little in favor of an endocrine source, though osteoarthritic changes occur in acromegaly. P. W. Nathan, with others, is quoted in favor of an infective origin, streptococci being lodged in the neighborhood of joints whose circulation is least active.

Treatment: Remedy any obesity, flat-foot, etc., capable of causing joint strain. Limit the exercise taken. Very early cases have a good chance of complete cure by absolute rest, the hip immobilized and no weight-bearing permitted. Such cases must be differentiated from gout and sciatica. There is not the same tendency to ankylosis which exists in rheumatoid arthritis, and which makes immobilization so dangerous in this latter condition. More advanced cases need leather spicas, radiant heat, and massage. Pain is relieved by ionization with salicylates and iodides, hot sand bags, and the inunction of salicylic acid and menthol. Arsenic and thymus gland are advocated internally. Removal of the head of the femur has given good results, the neck articulating in the acetabulum, while ankylosing the joint gives relief from pain at the expense of movement.—*J. A. Nutter, Montreal.*

CHRONIC INFLAMMATION OF THE KNEE JOINT AFTER INJURIES. Rost. *Klin. Woch.*, April 15, 1922.

The author is concerned with the slight chronic knee joint inflammation, often preceded by a very insignificant trauma, as a strain, or even where there has been no recognized trauma, and an extravasation of blood into the joint never existed. Author recalls Hoffa's work in 1904 on sclerosis of the anterior fatty body of the knee joint which followed slight trauma. Hoffa found that the anterior fat body placed under the quadriceps tendon became prominent, felt firm, often was pseudo-fluctuant, and was more or less painful. He removed the body. Other surgeons did likewise but their results were not as good as Hoffa's, and the subject was forgotten. Author believes there is a germ of importance in Hoffa's work. Anatomically the three fatty bodies are under the quadriceps tendon, in the popliteal space and on the femur extending to the border of the cartilaginous surface of the joint. Experimentally, author proved that inflammatory changes in the posterior fatty body inhibited extension and in the anterior body inhibited flexion. With joint inflammation after the injury the author could show, as in animal experimentation, that a circumscribed pathologic change may take place in the anterior fatty body when the neighboring synovial membrane histologically is absolutely normal. Author states that he could show exactly as with animal experimentation that in joint inflammation, post-traumatic, a circumscribed pathologic condition appears, particularly in the anterior fatty body, while its neighboring synovial membrane is completely normal. With regard to the origin of chronic knee joint inflammation with slight injuries, he places great value on the normal wearing away of the knee joint. The fact is that in a surprisingly large number of normal knee joints one finds spots where the cartilage has softened or degenerates. He

quotes statistics showing that only in 65% of cadavers of twenty to forty years is there no such cartilage degeneration. In corpses over forty years, 95% have the condition demonstrable. These areas become roughened and rub on the synovial membrane and irritate it. The injury to the knee joint here is from within out, as it were. These areas of degeneration are found mostly on the patella. Histologically they resemble arthritis deformans, but the process is circumscribed, while in a true arthritis deformans the whole joint is affected. He does not believe this degeneration to be an early stage of arthritis deformans, for if it were, every elderly person would have arthritis deformans. It is, of course, possible that arthritis deformans may develop from such a degeneration. As to the therapy: He advises rest for the early cases and then forceful massage. Hot air treatments are very acceptable, but author is not convinced of any special benefit from them. Large joint effusions have to be punctured. Extirpation of the fatty body is only to be done when complaints are severe and conservative treatment unavailing.—*Armin Klein, Boston.*

SCOLIOSIS.

GRADUAL CORRECTION OF SCOLIOSIS IN SEGMENTED PLASTER JACKET. J. Hanausek. *Revue d'Orthopédie.* March, 1922.

This article appears under the title, *Contribution au traitement de la scoliose par les corsets plâtrés*, and is an interesting presentation of the author's method. For a complete understanding one should refer to the original article for sketches of the comparatively simple mechanical appliances required. Procedure is based on the argument that force applied laterally to the prominent ribs increases rather than corrects the deformities, and that rotatory corrective forces alone are logical. Patient stands on the intersection of two folding cross-arms, from each end of which rises a stout upright. Traction bands are secured to these uprights; two bands, passed about upper thighs in opposite directions, hold the pelvis rotated in correct direction; a third band, pressing against the prominent ribs posteriorly, tends to rotate the trunk upon the pelvis. Details as to padding follow; removable pads are placed over parts to be rendered more prominent, as correction, and later over-correction, is obtained. Jacket is then applied, and several days later, while still on patient, it is sawn at the waist into two segments. These segments are made to rotate, the one on the other, by means of a stout hinge of special design, fixed at one side of the spine. Eyelets are also fixed to the segments, by which means padded levers can be attached for purpose of corrective rotation. Progressive, daily correction is made, and is maintained by means of bands hooked into the eyelets and half-encircling the trunk. Photographs are shown of a patient with a marked degree of rotary lateral deformity before treatment, and again eight months after treatment; the amount of correction, both as to curvature and rotation, is striking. After a certain period of progressive correction the author's method includes the use of a celluloid jacket, modelled after an ingenious plan to represent the maximum degree of correction obtained, and the practice of physiotherapeutic

exercises, etc. If necessary, the two processes are repeated. His method differs from Abbott's in that he uses the upright position for application of cast, arguing that unless correction is made against the maximum obstacles the final gain will be less. A review of this article gives one the impression that this method, as practised by the author, is distinctly worth an extensive trial.—*Roades Fayerweather, M.D., Baltimore, Md.*

Is There an Operative Treatment of Scoliosis? H. Hoessly. *Zeit. f. Orth. Chir.*, 1921, xli, 3 H., p. 193.

The author believes that operative treatment is justifiable in the paralytic and severe rachitic cases. The operation is planned, not at the height of the curve on the convex side, but at the point of greatest convexity, and is in the nature of bone transplantation. The results in three cases, after a lapse of one and a half to two years, showed straighter backs, with strong mechanical supports. The author suggests an approach through an abdominal incision in operations upon the lumbar vertebrae, especially where developmental anomalies are present.—*Roland Hammond, M.D., Providence, R. I.*

Operative Treatment of Scoliosis. S. Kleinberg. *N. Y. Med. Jour. and Med. Record*, July 19, 1922, p. 93.

The author feels that 60 to 70 per cent. of scoliosis cases can be improved by corrective jackets worn for a long period of time, and that by putting these patients in hyperextension on a frame with traction at the head and pelvis a maximum amount of reduction is obtained in 8 weeks.

On removing these patients from the frame the deformity recurs and the author is doing a fusion operation on a single curve, which is a combination of the Hibbs and Albee technique, combined with a beef bone graft about 8 inches long.

This is followed by recumbency without the frame for 10 days, then the frame and traction for 8 weeks, followed by a plaster jacket or brace for 3 to 6 months.

So far the results have been good.—*Edward S. Hatch, M.D., New Orleans.*

OSTEOMYELITIS.

Bone Diseases: Non-Suppurating Osteomyelitis (*Garré*); Infectious Ossifying Periostitis (*Bloodgood*). Joseph C. Bloodgood, M. D. *Journal of Radiology*, Aug., 1922.

Bloodgood refers to infectious ossifying periostitis in this article. The first case he reports is a patient who, eight years before, had a diagnosis of sarcoma made of the upper end of the femur, and amputation advised. He had refused

the operation and sought advice elsewhere, and finally conservative measures were carried out. He is alive and well today, and the condition less prominent than at that time. This one case emphasizes particularly the fact that diagnosis of sarcoma has probably often been made in this condition and limbs sacrificed.

The cases he mentions evidently belong to the group described by Dr. S. Fosdick Jones, in the *Journal of the American Medical Association*, September 21, 1921, who credited Garré with establishing the entity.

He reports a rare case involving the hip-joint and upper end of the femur, and gives as the etiological factor gonorrhea.

He also mentions another case involving the upper end of the femur, but not the hip-joint, in which the etiology was considered as being due to an abscessed tooth.

In the differential diagnosis he stresses the point that the medullary cavity is more readily to be outlined in the x-ray than is the case when the condition is sarcoma.

The author reports in this article two cases that he considers to be multiple infectious ossifying periostitis, and one in which the bones of the skull were involved.

His conclusions are as follows:

1. Apparently there is a definite type of non-suppurating ossifying periostitis of sclerosing osteomyelitis. I have sufficient cases to demonstrate that trauma and syphilis may produce it. It is observed as a post typhoid and post-influenza lesion, and apparently it may be secondary to any type of infection.

2. The most important points in treatment are the administration of salvarsan intravenously and a search for the focus of infection, which, when found, should be removed. I have no evidence as yet that incision with removal of the new bone formation is helpful.—*M. S. Henderson, Rochester, Minn.*

TRANSPLANTATION OF ENTIRE FIBULA IN CASES OF LOSS OF TIBIA FROM OSTEOMYELITIS. W. Russell Mac Ausland and A. F. Sargent. *Annals of Surgery*, July, 1922, p. 1.

The value of this transplantation as compared with tibial graft consists in:

(1) Less danger of infection, on account of small exposure in healthy tissues.

(2) Blood supply of fibula is not disturbed, so it does not die.

(3) The transplant rapidly hypertrophies to take care of added weight and leaves no defect from absence of fibula.

(4) Fracture of graft does not occur.

The entire transplant of fibula is only used in cases where there is a large defect in the tibia and disability is complete.

The lower and upper epiphyses of tibia are usually not destroyed in osteomyelitis of tibia.

The technique is described:

He first transplants the severed upper end of the fibula into a cup-shaped depression made in the end of the head of the tibia. The periosteum of fibula is left attached to both the head of fibula and the transplant. This often forms

a bony bridge and gives additional support to the upper end of bone. No non-absorbable material is used. The leg is put up in a plaster cast from toes to mid thigh and left for two months.

Then the lower end of the fibula is similarly severed and put into lower end of tibia. After two months, weight bearing is allowed with the leg in a plaster cast, or a caliper splint.

Four cases are reported. The literature of the subject is reviewed. The article is illustrated by good drawings of the operation, and a number of very interesting x-ray plates showing the results of operation and the marked hypertrophy of the fibula after use.—*F. G. Hodgson, M.D., Atlanta, Ga.*

CONTRIBUTION TO STUDY OF OSTEOMYELITIS OF THE RIB. A CASE COMPLICATING CHICKEN-POX. P. Philardeau. *Revue d'Orthopédie*, May, 1922.

The rib is not often involved in any type of osteomyelitis, and the author has been unable to find a single case reported as developing in the course of chicken-pox. The lesion in his case was in the anterior portion of the left 10th rib. Recovery followed a partial resection and drainage. Organism isolated was identified as the *enterococcus* (see note*); said to be a very rare causal factor in osteomyelitis. Author takes occasion to discuss the anatomical development of the rib, with relation to site of infection at different ages.—*Roades Fayerweather, M.D., Baltimore, Md.*

*Note: In English terminology, *micrococcus ovalis*, or *streptococcus gracilis*.

ANALYSIS OF 160 CASES OF OSTEOMYELITIS WITH END-RESULTS. J. S. Speed. *Southern Med. Jour.*, Sept., 1922.

This series includes only hematogenous infections, 29 localized and 131 diffuse types. Of the diffuse cases 70% were between 8 and 14 years of age; 40% tibia, 35% femur, 7% humerus, 7% radius and ulna and 2% fibula. In 16% two or more bones were involved. Positive x-ray findings usually appear from two to ten days after onset of acute symptoms, so that a negative radiogram during the first ten days does not exclude bone disease. In some cases this applies to even a longer period. Pictures must show clear detail and even then a sequestrum often fails to show clearly in chronic eburnated bone.

Twenty-one patients were in the acute stage, of whom seven died. Trap-door drainage was employed. In three of ten cases traced no further operation was required for cure. He does not say how soon after onset these were drained.

In the chronic cases the usual procedure of removing sequestra, thorough exploration of neighboring medulla and conversion of cavities and tunnels into saucer-shaped basins, was employed. In acute cases the clean-up operation is postponed until there is sufficient new bone laid down to preserve continuity. Nothing is said of Dakin's solution or other special postoperative care of wounds. Possibly the author considers, and rightly so, that this makes little difference if the operation is thoroughly and properly done.—*R. W. Billington, Nashville.*

THE VALUE OF DAKIN'S SOLUTION IN THE TREATMENT OF ACUTE AND CHRONIC OSTEOMYELITIS. A. O. Wilensky, M.D. *Annals of Surgery*, June, 1922, p. 708.

Only cases of osteomyelitis due to the common pyogenic organisms are considered.

The pathology of acute and chronic osteomyelitis is quite clearly outlined.

The factors which determine the efficiency and success of the Carrel-Dakin treatment are: (1) The removal of all sources from which continuing or repeated reinfections can take place; (2) Complete asepsis in the dressing; (3) Rigid attention to details; (4) Chemically correct solutions; (5) Intimate contact between the infected surfaces and areas and the antiseptic solution.

Each of these headings is discussed.

On account of the difficulty in carrying out all of the conditions the author concludes that very few cases are really suitable for the carrying out of this method. If a radical operation is performed and the wound suitably prepared for the use of this method, it is found that many cases will heal by granulation and strapping the wound edges together just as promptly as if the Carrel-Dakin method had been used.

Wound healing may occur by either method, but relapses are very prone to occur.—*F. G. Hodgson, Atlanta.*

FRACTURES AND DISLOCATIONS.

SPIRAL FRACTURES OF THE TIBIA AND FIBULA. John A. Caldwell. *Annals of Surgery*, June, 1922, p. 717.

The spiral fracture is caused by a twist of the leg with the foot fixed, while carrying the body weight. Usually the tibia is fractured in the lower third and the fibula in the upper third. The author says it is impossible to reduce this fracture by traction, and even with open operation it is very difficult to reduce. He concludes that all cases unoperated result in some deformity and prolonged disability; so he advises operation in all cases.

Four methods are available: (1) plating; (2) intramedullary dowel; (3) bone screws and (4) banding. He prefers the last method, using the Parham Martin band. He waits ten days before operating. He describes his technique and advises removal of the band in two to three months. He reports ten cases. There were two surgical infections.—*F. G. Hodgson, Atlanta, Ga.*

FRACTURE OF THE CAPITELLUM AND TROCHLEA. Martin C. Linder. *Annals of Surgery*, July, 1922, p. 78.

This is an uncommon fracture. Seventeen cases found in literature. The lesion is a splitting off of the articular surfaces of the lower end of the humerus with a thin strip of cancellous bone. It is an *intracapsular* fracture and the fragment lies free in the capsule, usually in the front of the humerus, but it may be posterior. It is caused by a fall or a blow on the flexed forearm. The

chief clinical features are: (1) Spontaneous pain in the region of the fracture, not dependent upon motion; (2) No change in the normal landmarks of the elbow; (3) Progressive limitation of the motions of the elbow-joint to fifteen degrees; (4) Finding on palpation of a bony projection in the ante-cubital fossa; (5) Crepitus caused by loose body in the joint.

The x-ray picture is quite characteristic and makes the diagnosis definite. The best treatment is excision of the fragment. Reposition has been tried but callus formation blocks the motion of the joint.

Three cases are reported, with good x-ray plates.

References to the literature are added.—*F. G. Hodgson, Atlanta, Ga.*

RECURRENT DISLOCATION OF THE PATELLA. W. R. MacAusland and A. F. Sargent. *Surg., Gyn. and Obstet.*, July, 1922.

The etiology of the condition is discussed very fully, injury and excessive knock-knee being the chief factors. Among contributory factors are considered heredity, muscular weakness, flat-feet, elongated patellar tendon, imperfect development of the patella, imperfect development of the external condyle of the femur.

The initial attack is most painful, and is usually followed by acute synovitis of the knee-joint.

Treatment of the acute attack calls for three weeks of plaster immobilization.

Recurrent attacks may be treated from four viewpoints:

1. Support:—By pad or knee-brace.
2. Stimulation:—By baking, massage, exercises.
3. Correction of static errors:—*e.g.*, Whitman plate for flat-feet.
4. Operation.

Of operative methods, capsulorrhaphy alone is a failure. Transplantation of part of the patellar tendon was employed in some of the earlier cases, but was considered less satisfactory than transplantation of the bony insertion of the patellar tendon.

The technique of both these operations is described and illustrated. Abstracts of 16 cases are given. A summary of the views of several previous writers on the subject of recurrent dislocation of the patella concludes the article. A short bibliography is appended.—*Alexander Gibson, Winnipeg.*

THE TREATMENT OF FRACTURES. Major Tom. S. Mebane. *Military Surgeon*, Aug., 1922.

The paper deals in a broad way with the treatment of fractures and necessarily cannot be very specific. The author emphasizes the fact that much was learned regarding the treatment of compound fractures during the war, but that the institution of these methods into the treatment of simple fractures is bad and the tendency to apply war-time methods to treatment of simple fractures is to be condemned.

The author emphasizes the fact that a fracture should first be reduced and then splinted, and not depend upon any type of splinting alone to do the work. He takes up the common fractures, such as the Colles fracture, and in speaking of fractures of the shaft of the ulna and radius says that the forearm should always be placed in full supination.

The after-treatment is emphasized and physiotherapy given a definite place in the after-care.

The author's indications for operative treatment are rather limited. He says that fractures of the patella and fractures of the olecranon should always be operated on, and certain fractures of both bones of the forearm and lower third of the humerus very frequently require operation.

His summary is as follows:

1. All fractures should be splinted before transportation. For this purpose, except under war conditions, coaptation splints, Thomas or Keller leg splint, and Cabot posterior wire splint, are the splints usually required.
2. Many compound fractures can be converted into simple fractures by prompt application of iodine and a sterile dressing. Where considerable laceration of the soft parts has occurred, débridement with primary or secondary closure should be practised.
3. Infected compound fractures should be treated by Carrel-Dakin technique with suspension in Balkan frame and traction to preserve alignment.
4. Simple fractures and compound fractures present differences which require that they be handled differently.
5. Convalescence in fracture cases can be shortened and function conserved by employment of physiotherapeutic measures, early use of the part, and employment of braces and supports until callus becomes firm.—*M. S. Henderson, Rochester, Minn.*

THE DIFFERENTIAL DIAGNOSIS OF SPONTANEOUS FRACTURE-LIKE GRAINING IN THE BONES OF HUNGER OSTEOPATHY. W. V. Simon. *Archiv f. Orth. u. Unfall-Chir.*, 1920, xviii, 1-2H., p. 111.

Recently disturbances of the skeletal system have been observed, caused by disturbances of the endocrine system following faulty nutrition or infection. These bony changes are fracture-like splits in the graining of the bone and occur in young and old, and in both sexes. The lower end of the femur and the upper end of the tibia are most frequently involved, but the ribs, radius, ulna, neck of the femur, and pubis are also affected. The x-ray appearances of this condition show bony defects, roughly round, oval or elongated, and small in size. They begin at the cortex and extend inward, gradually enlarging as they penetrate the bone substance. The surrounding periosteum, cortex, and medulla are normal in some cases; in others the periosteum is thickened as in syphilis. These patients are ill-nourished and anaemic, and complain of pain over the bone involved. Pressure over the bone is painful and slight oedema is often present. It is necessary to differentiate between syphilis, periostitis, and late rickets and nutritional disturbances. The condition most resembles a small cortical gumma, but the Wassermann reaction has been negative in these un-

complicated cases. It can be differentiated from spontaneous fracture by lack of history of injury and because the defect occurs in a part of the bone not subjected to strain. Simon ventures the opinion that a syphilitic bone condition cannot be ruled out in some of these cases. In one such case, under arsenic, iodides, and calcium, a cure was effected in three months, although the Wassermann reaction was mildly positive a year later.—*Roland Hammond, M.D., Providence, R. I.*

RACHITIS.

SCHLATTER'S DISEASE.—A FREQUENT SYMPTOM OF LATE RICKETS. Bernhard Hinrichs. *Zeit. f. Orth. Chir.*, 1921, xli., 3H., p. 217.

Schlatter's disease is a functional disturbance of growth occurring at the time of puberty, affecting the tuberosity of the tibia, and running a chronic course, and usually resulting in a thickening of the tuberosity. There is transitory swelling on both sides of the ligamentum patellae, and in severe cases swelling of the knee-joint and atrophy of the quadriceps. After an exhaustive embryological study, Schlatter concludes that a locus minoris resistentiæ exists at the junction of the upper part of the tuberosity with the lower part of the apophysis and that this is subject to pathological changes following injury. Periostitis at the insertion of the ligamentum patellæ, partial fracture from pull of the quadriceps, osteochondritis, a rarefying process, apophysitis tibialis adolescentium, epiphysitis dissecans traumatica resulting in separation of a fragment of bone from the tibia, and inflammation of the pretibial bursa are the conclusions reached by various writers as to the nature of this condition. In many cases a localized inflammatory process is found in the tuberosity itself. Pathological changes at the junction of bone and cartilage have been found which closely resemble those of late rickets, as seen in adolescent knock-knee. There is evidence to show that a systemic disease is present, resulting in weakening of the tissues, which permits a rupture of the periosteum and resultant thickening of this structure. Similar periosteal thickening is found in other bones. While trauma, inflammation, and disturbances of growth are recognized as etiological factors in this disease, many cases have been observed in which the well-known symptoms of late rickets were present. The administration of phosphorus is suggested as likely to be beneficial. In conclusion the author states that in many cases Schlatter's disease is a symptom of late rickets. There is a tendency of the upper epiphysis of the tibia to show certain changes during the period of normal development which are induced either by direct or indirect trauma. In all cases where trauma is not a factor, late rickets must be taken into consideration. — *Roland Hammond, M.D., Providence, R. I.*

ADOLESCENT RICKETS. REPORT OF 5 CASES. Philip Lewin. *Surg., Gyn. and Obstet.*, July, 1922.

A short review of the literature is given, followed by detailed consideration of the etiology. In the writer's opinion, "it is entirely a question of bone meta-

bolism," including the influence of "endocrinology and vitamins." A suggestion is made that "disturbed thymus balance might cause bone and muscle changes."

The pathology and the symptoms of genu valgum and genu varum are then considered. Adolescent rickets has to be differentiated from osteomalacia and from osteitis deformans.

In regard to treatment the writer recommends osteotomy. The inevitable "Wolff's Law" is quoted in full. Histories of 5 cases are submitted. Numerous diagrams and photographs of two cases are included.—*Alexander Gibson, Winnipeg.*

NEOPLASMS.

CHRONIC BONE ABSCESS. Walter M. Brickner. *Surg., Gyn. and Obstet.*, July, 1922.

The author describes his technique for the evacuation of a chronic bone abscess. An incision about 2 inches long is made down to the periosteum. Through this and into the bone, a drill about one-fourth inch diameter is driven deep enough to permit the escape of pus. The drill is removed and nothing else is introduced into the bone. A small drain of folded rubber dam is laid in the soft parts down to, but not into, the opening in the bone, and the wound is otherwise closed by sutures.

The author then discusses reports by Bevan and MacWilliams of cases of chronic bone abscess in which primary and secondary suture respectively was followed by healing. A distinction is drawn between afebrile—presumably sterile cases—and febrile cases, which are really recurrent acute osteomyelitis. A full report is given of a case of bone abscess in the tibia in a patient, aged 32, who had suffered from osteomyelitis at the age of 11. Treatment by Brickner's technique was followed by two days of high temperature, normal being reached two days later. The patient left the hospital 24 days after operation. "A roentgenogram made 18 months after operation shows that the drill hole is closed by bone, but that the abscess cavity, although reduced in size, is not obliterated." "We should eliminate from our future text-books the statement that Brodie's abscess is usually tuberculous." Excellent advice, if necessary.—*Alexander Gibson, Winnipeg.*

ROENTGEN DIAGNOSIS OF THE MORE IMPORTANT TUMORS OF THE LONG BONES. Bernard H. Nichols. *Surg., Gyn. and Obstet.*, Sept., 1922.

Author has secured a remarkable collection of bone plates from the various hospitals of New York, representing practically all the types of bone tumors found in the literature. He has added a classification of bone tumors. (1) Their origin—whether medullar or cortical; (2) Whether or not they are characterized by bone production, by bone destruction or by both; (3) The resultant condition of the cortex, whether expanded or destroyed; and (4) Whether they are invasive or non-invasive in their growth.

Malignant tumors do not cross a joint, as cartilage seems to be a barrier to malignancy, so that a lesion involving both sides of a joint is always a benign process.

Each type of bone tumor is described in detail and the article is beautifully illustrated.—*Thomas Madden Foley, Washington, D. C.*

MISCELLANEOUS.

KINEPLASTIC AMPUTATION OF FOREARM. TRIMOTOR. G. Bosch Arana. *Surg., Gyn. and Obstet.*, Sept., 1922.

The benefits to be derived from the regular practice of such amputations are incalculable. Kinematization, or kineplasty as it has also been termed, is a procedure which no operative method hitherto known can put into practice. By means of kineplasty there is constructed on the segment of the amputated limb a kinetic element termed "motor." Author began furnishing stumps with one motor (unimotor). He now uses three motors (trimotor). The technique is that described by Pellegrini. The first motor was constructed by suturing in handle form the superficial flexor muscles with deep lying flexors. The second motor was constructed on the under surface of the forearm with the common extensor muscles of the fingers. *The larger the motor "eye" the surer will be its practical results.*

Under Professor Putti's direction, the mechanical problem has been studied with singular success, and the orthopaedist, Fusaroli, has constructed a hand for a bimotor of forearm. This is the one which author placed on his patient. Article is well illustrated.—*Thomas Madden Foley, Washington, D. C.*

TREATMENT OF CHRONIC SYNOVITIS OF THE KNEE-JOINT. G. G. Atkins. *British Medical Journal*, June 17, 1922, p. 948.

The importance of this condition in army practice is pointed out. The knee-joint is full of fluid, while the vastus internus muscle is invariably wasted and cannot be fully contracted. In old-standing cases some lateral instability of the joint is usually present. Tenderness on pressure may be elicited over various points around the head of the tibia. In the majority of cases the semilunar cartilage is not at fault, and a diagnosis of injury to it should not be made unless there is a very definite history of locking of the joint at the time of the original injury. A strain of the internal lateral ligament is a common cause of chronic synovitis, and very often simulates a torn cartilage. The principal nerve of supply to the knee-joint also supplies the vastus internus, hence injury to the knee reflexly inhibits the action of this important muscle. So long as the vastus internus suffers lack of tone the effusion will recur at the slightest strain, hence one breaks the vicious circle by re-establishing tone in this muscle. This is done by increasing the blood supply to the area affected, (1) contrast baths; (2) limited active exercise of all the muscles about the

joint; and (3) massage. The patient is not confined to bed, but allowed light exercise over even ground. Occasionally a tight bandage over wool is applied to the knee at night. Tender points found at the insertion of tendons about the joint are due to local strain. Care must be taken in the diagnosis to eliminate intra-articular conditions, tuberculosis of the knee-joint, and also an effusion of the joint due to an hypertrophic infrapatellar pad of fat, in which case suitable limitation of complete extension must be provided for.—*J. A. Nutter, Montreal.*

DISTURBANCES OF EPIPHYSEAL NUTRITION IN MAN. Axhausen. *Münch. med. Woch.*, June 16, 1922.

A great many joint bodies are undoubtedly the end-result of a circumscribed traumatic lesion of the cartilage. But there is still another kind of free joint bodies, particularly in the knee. The characteristic of this typical "cartilage-bone" body is that a closed, non-fissured joint cartilage covering covers a uniformly wedge-shaped or oval necrotic piece of bone enclosing dead marrow, with no break in continuity to be seen. The origin of these epiphyseal wedge-shaped necroses, as found in the earlier stages of the typical cartilage-bone bodies, has proved experimentally to be completely impossible from a traumatic fissure. The author previously showed the formal agreement of typical cartilage-bone bodies in formation with the small tuberculous subchondral sequestra in the x-ray and spoke of his opinion that the question here, as there, was of a disturbance of nutrition by embolic plugging of the epiphyseal end arteries, only with the difference that in the preliminary stages of the free joint bodies the bacterial infection is of no concern or is quickly overcome by the body, so that only the mechanical effect of the vessel occlusion appears. The agreement between the joint body early stages and the tuberculous subchondral sequestra is not limited only to form, but extends also to the site. Such preliminary stages of the joint bodies appear in other joints. Koehler, in 1920, pointed to a unique pathological picture in the second or third metatarsal head, with an area of thickening surrounded by clear zones, flattening of the head, formation of a roll about the margin, broadening of the neck, and finally severe deformity. The demarcated, thickened, wedge-shaped bony part of the x-ray picture, which gives the impression of a tuberculous wedge-shaped sequestrum, histologically appears as an epiphyseal wedge-shaped necrosis. He rules out trauma as a cause, so that there remains no other possibility but an embolic-mycotic disturbance of nutrition, without any infection of concern. After such affirmations he believes that the mycotic wedge-shaped necroses, with infection excluded or quickly overcome, play an important rôle in the etiology of juvenile arthritis deformans.—*Armin Klein, Boston.*

A NEW METHOD OF MASSAGE AND ELECTRIC STIMULATION IN CONTRACTURES AND PARALYZED MUSCLES. Hanausek. *Revue d'Orthopédie.* July, 1922. Page 345.

The essence of this method is that the muscle should be relaxed while being treated. For example, in pes equinus the contracture of the achilles should be

overcome by stretching as much as possible during electric stimulation or massage of the paralyzed extensors. For maintaining this stretching the author uses stirrups and weights, arranged over pulleys if necessary. Some illustrations show at a glance the author's method of maintaining the deserved relaxation of the different muscles.

As far as I have observed, this method has been employed by all well trained workers here in America, so it cannot be regarded as a new procedure. However, it is well to call attention to it in order that it may be given deserved emphasis.—*William Arthur Clark, Pasadena.*

FURTHER REPORT ON CLASSIFICATION OF BIRTH PARALYSES AS ENDOCRINES. L. B. Clarke. *Southern Med. Jour.*, July, 1922.

The author believes that many of the so-called birth paralyses with mental and physical defects are in reality endocrine disturbances. Thirty cases have been studied and treated. Cretins are not included. Pluriglandular treatment has given best results. The younger the patient, the better the result. Four cases over seven years showed no improvement. One case of retarded mental and physical development is reported as completely cured. This case, as reported, does not seem to be a true congenital cerebral spastic type, and one wonders if he considers these hemi-, para-, and diplegics as endocrine disturbances.—*R. W. Billington, Nashville.*

AUTOGENOUS VERSUS HETEROGENOUS BONE PEGS. George de Tarnowsky. *Surg., Gyn. and Obstet.*, Sept., 1922.

The clinical behavior of a beef-bone graft depends entirely on the relative activities of the osteoblasts and the osteoclasts:

1. With proliferation of new cells from the living proximal and distal ends of the fractured bone keeping pace with absorption of dead cells from the graft, complete disappearance of the latter coincides with complete union of the fracture or filling in of the defect.

2. With hyperactive new cell formation and sluggish absorption, the graft constitutes a sequestrum which either eburnates and remains in a state of quiescence or acts as an irritant foreign body with sinus formation and periodic extrusion of dead bone spicules.

3. With hyperactive bone absorption and sluggish new-bone formation the graft disappears by combined extrusion and absorption before union or filling in of the defect has taken place.

The factors which enable us to attain the ideal, *i.e.*, an even balance of absorption and proliferation are: first, the thorough trimming off of dead bone proximally and distally with curette and chisel; second, firm approximation of the bone graft to living bone; and, third, absolute asepsis.

Finally it has seemed to us that the term infection, as applied to bone surgery, is too loosely used and that in many cases of so-called septic results we are merely dealing with type three, *i.e.*, rapid necrosis of the graft without in-

fection—using the latter term in its proper sense. In other words, subacute osteomyelitis, with no antibody reaction on the part of the individual, should not be classed as an infection but as ordinary tissue necrosis.—*Thomas Madden Foley, Washington, D. C.*

OSTEOGENESIS IMPERFECTA. Gg. Franke. *Zeit. f. Orth. Chir.*, 1921, xli, 1-2H., p. 158.

From an exhaustive study the author believes that the former separation of osteopsathyrosis idiopathica from osteogenesis imperfecta is unwarranted. The condition is not a symptom but gives the explanation of the bone process. Osteogenesis imperfecta is a disease of the osteoblastic cells of the periosteum and marrow, but the epiphyses are normal. In rachitis and in juvenile osteomalacia, which are constitutional diseases, changes in the cartilage are common. In osteogenesis imperfecta fractures occur before birth or in the early years of life, while in osteomalacia they occur around puberty, the period of greatest bony growth. The pelvis is involved in osteomalacia, a condition which is almost unknown in osteogenesis imperfecta. The cause of the brittleness of bones in osteogenesis imperfecta is found in the inadequate activity of the osteoblasts in normal enchondral ossification. In juvenile osteomalacia the bones are normal in structure, but calcium salts are absent.—*Roland Hammond, M.D., Providence, R. I.*

TYPICAL FLEXION CONTRACTURE OF THE GREAT TOE AFTER PROLONGED FIXATION. O. Kleinschmidt. *Arch. f. Orth. u. Unfall-Chir.*, 1920, xviii, 1-2H., p. 120.

Among the rarer deformities of the toes, there occurs a flexion contracture of the great toe at the metatarso-phalangeal joint following prolonged fixation of the foot after long recumbency in bed. In uncomplicated cases there was found a contracture of the flexor brevis hallucis muscle, together with a displacement of both sesamoid bones from the normal situation to the outer and posterior portion of the joint surface. In severe cases the sesamoid bones were fixed to the joint capsule by adhesions. The toe shows few changes beyond the contracture, and the other toes are normal. X-ray examination shows the displacement of the sesamoid bones mentioned above, and also in severe cases a flattening and broadening of these bones. The progress is usually favorable. Treatment by conservative measures such as baking, massage and active movements, failed in severe cases because of the severe nature of the contracture. Tenotomies or lengthenings of the flexor longus hallucis and flexor brevis hallucis were unsuccessful and extirpation of the head of the first metatarsal bone was rejected as too radical an operation. The best results followed the removal of both mesial and lateral sesamoids from beneath the metatarsal head. It was found necessary to sever by a transverse incision the fibrous tissue in which lies the tendon of the flexor longus hallucis. The foot is splinted with the toe in dorsal flexion. The results in three cases were excellent, with no functional disturbances, and the patient was up and around in two weeks.—*Roland Hammond, M.D., Providence, R. I.*

INDIVIDUALITY OF THE METAPHYSIS. R. Tillier. *Revue d'Orthopédie*, Jan., 1922.

Tillier comments on the actual existence of a metaphysis, more or less distinct and isolated, anatomically, from the diaphysis, as well as from the epiphysis, by transverse lamellae of bone. The latter are sometimes very distinct in young individuals, as he has demonstrated in long section of bones. This should be borne in mind in the reading of x-ray studies. Author goes on to discuss briefly the significance of a more or less isolated metaphyseal region as related to the localization and evolution of some pathological processes. Admitting that exceptions are many, most often tuberculosis originates in the epiphysis; syphilitic bone disease in the diaphysis; osteomyelitis in the metaphysis. Owing to its more acute character, osteomyelitic infection usually breaks through the anatomical barriers of the metaphysis; tuberculosis and syphilis are less apt to do so. Reference is also made to the possible influence of the transverse bone structure separating metaphysis from diaphysis in determining the site of fracture in certain cases; also, in regard to the shaping of certain deformities of growth.—*Roades Fayerweather, M.D., Baltimore, Md.*

ROENTGENOLOGY OF SYPHILIS IN BONE. E. H. Skinner. *American Journal of Syphilis*, Jan., 1922.

Syphilis in bone is usually a constructive osteoplastic process. The clinical findings are not as extensive as the x-ray findings.

Bone lesions cast shadows which are *constructive* in osteomyelitis and syphilis. Bone lesions cast shadows which are *destructive* in tuberculosis and malignancy. Bone tumors which are *constructive* are usually *benign*. Bone tumors in which *destructive* changes predominate are malignant.

The bone lesions of syphilis may be rated as constructive processes in all except syphilitic lesions of the plates of the skull. Charcot joint may be destructive but the great amount of calcareous débris thrown out at the enlarged joint indicates the constructive nature of syphilis of bone. The constructive character of syphilitic bone shadows is seen in the laminated veiling of the bones of the hand or foot in syphilitic dactylitis. Distinctly opposite shadow values are seen in tubercular spina ventosa, which shows areas of softening and local caries within a slightly expanded bone outline. Sabre tibia is a typical constructive process.

The joint lesions of syphilis, other than Charcot joint, rarely show violent destructive changes but lean toward hypertrophic pathology with perhaps an isolated area of softening in a localized gumma. The zone of proliferative constructive reaction can be determined. This may confuse syphilis with Perthes' disease or Koehler's disease, but not with tuberculosis.

Bones seem to display a resistance to syphilitic invasion by piling up a positive resistance or a zone of defense, while in tuberculosis there is a negative resignation to the progress of the invader.—*W. G. Elmer, Philadelphia.*

CASES OF INFECTED KNEE-JOINT TREATED BY INCISION, DRAINAGE AND MOVEMENT. Philip Weatherbe. *Lancet*, Dec. 17, 1921.

After describing four cases of infected knee-joints, three of them being in children, and a perfect functional result having been obtained in each case, the author states the following conclusions:—

When the diagnosis is septic knee-joint, the treatment should be at the earliest possible moment a free opening of the joint by lateral incisions, four to six inches long on either side of the patella, followed by thorough irrigation of the joint, breaking down all adhesions, manipulation by full flexion and extension, introduction of several rubber drainage tubes about the size of the little or big finger according to the size of the patient, application over the wounds of wet boric lint covered with oiled silk, and creation of continuous drainage of the joint by capillary action.

The dressing should be changed once a day with removal of tubes, irrigation, and full flexion and extension. This should be repeated daily until the wounds are healed. Failure will occur if the incisions are not large enough, if the joint is not fully flexed each day, if the dressings are not kept wet.

The changing of dressings and movement of the joint are comparatively painless.

This method of treating septic knee-joints apparently gives the patient the best chance regarding his life and the function of his limb.—*W. G. Elmer, Philadelphia.*

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(1) Concerning the Disease Characterized by the Flattening of the Upper Epiphysis of the Femur. A. Legg, p. 585.

(2) Some Remarks on Coxa-plana, Wrongly Called Osteochondritis of the Upper Epiphysis of the Femur. J. Calvé, p. 592.

(3) On the Origin and the Final State of Coxa-plana. H. Waldenstrom, p. 599.

(4) Osteochondritis of the Hip and its Relation to other Osteochondritides of Infancy. G. Nové-Josserand, p. 606.

(5) Osteochondritis of the Hip in the Adult. L. Tavernier, p. 614.

(6) Some Remarks on Osteochondritis Deformans Juvenilis of the Upper Epiphysis of the Femur. E. Sorrel, p. 625.

(7) On Coxa-plana. G. Rottenstein, p. 633.

(8) Osteochondritis Deformans and Hypertrophy of the Upper Extremity of the Femur by Exostosis of Growth. P. Guibal, p. 644.

(9) Atypical Characteristics of Coxa-plana. J. Moreau, p. 652.

(10) Deformities of the Hip with Subluxation. M. Van Neck, p. 656.

(11) Consideration of Coxa-plana, Infantile and Adolescent. F. Delcroix, p. 659.

(12) A case of Osteochondritis of the Hip. Delchef, p. 669.

Archives Franco-Belges de Chirurgie, April, 1922.

This entire number of the Journal is devoted to that obscure condition of the hip joint known variously as Legg's, Calvé's, or Perthes' disease, osteochondritis juvenilis, coxa-plana, caput planum, etc.

Legg mentions briefly his first case, noted in 1905, which was being treated for tuberculosis of the hip, but which gave an x-ray picture very different from that of hip disease. He then describes the clinical picture as one of insidious onset with limp and little pain and slight limitation of abduction and internal rotation. A few months after the onset the x-ray shows the characteristic mushroom or cap-like deformity of the head and the thickening of the neck. In general, the malady runs its course without incidents. Occasional acute exacerbations are quickly relieved by fixation. The end-result is slight atrophy of the limb, slight shortening (1/4-2 cm.) and slight limitation of abduction and internal rotation. The x-rays of old cases show deformity of the head and neck out of all proportion to the small amount of disability. He refutes the theories of rickets, congenital anomaly, alteration in blood supply of the head, chondrodystrophia, infection, and syphilis as being the cause, and persists in his former belief that the condition is due to disturbances in the circulation of the epiphyseal line caused by trauma. His paper is illustrated by x-rays showing the evolution and the terminal state of the condition.

Calvé reports four rather unusual cases. The first followed an attack of chicken-pox, and the x-ray in the beginning was negative, but eight months later showed typical coxa plana. In one of the other cases the epiphysis had at one time completely disappeared and three and five years later had regenerated to a typical coxa plana. His first case he believes undoubtedly due to chicken-pox and the others had attenuated infections, sore throats, adenoids, etc. The cutaneous tuberculin reaction was negative in all of his cases. (His paper is illustrated with x-rays of the reported cases). He believes that clinically there is a latent stage of one to one and a half years preceding the osseous change, then the head atrophies and fragments and is later regenerated from the bony islets.

Waldenstrom believes that the condition is a disturbance in the function of the epiphyseal line, which begins between the ages of 5 and 7 years and leads to atrophy and fragmentation of head and later regeneration and slow evolution which lasts until adult life. He presents one case followed from the age of 7 years to the age of 21 years, with continued changes throughout this period. He compares coxa plana with Osgood-Schlatter's disease of the tibial tubercle, Köhler's disease of the scaphoid, apophysitis of the os calcis, and so-called congenital coxa vara.

Nové-Josserand's paper deals with atypical cases of coxa plana, and he asserts that lesions of the acetabulum are more frequent in this condition than are generally recognized and that all transitions exist between coxa plana, coxa vara, and osteoarthritis deformans juvenilis, and that all may present areas of decalcification in the neck. These conditions are either due to an entirely new disease of unknown etiology or certain individuals have tissues which are very susceptible to trauma or infections, which have no effect on normal individuals.

Tavernier begins his article with the statement that it seems paradoxical to speak of osteochondritis in an adult, but presents three observations of adult soldiers who developed hip symptoms after contusions, and in whom the x-rays showed marked deformity of head. Though it was not possible to obtain a history of any trouble in childhood these are regarded as cases of osteochondritis in infancy in which the symptoms were so mild as to escape the notice of the

parents. In these adult cases the clinical reactions were severe and may result in ankylosis. The osteochondritis may co-exist with osteoarthritis. The condition is due to some disease of unknown cause which in childhood affects the cartilaginous head, causing osteochondritis; in adolescence it affects the neck, causing coxa vara, and in the adult the robust bone resists deformity and arthritis develops.

Sorrel remarks that the diagnosis is easy with the x-ray and the treatment is simple. He sketches the clinical and x-ray findings and does not accept any of the various theories of etiology as proven and feels that the condition may be due to some endocrine disorder. The immediate prognosis is good, as practically normal function is usually regained within two years, but from the reports of the old cases in the literature the end-results range from slight limitation of movement to almost complete ankylosis. However, as Sorrel points out, these severe cases were not observed in infancy and the diagnosis is questionable. Nevertheless, one is justified in giving a guarded prognosis as regards the ultimate result.

Rottenstein, from the x-ray standpoint, divides the condition into an early stage of atrophy and fragmentation of the head, a stage of repair, and a late stage characterized by osteophytes, deformity of the acetabulum, and ischium varum. He reports one case following the reduction of a congenital dislocation of the hip, a questionable case following pneumonia at the age of 3½ years, one case of bilateral coxa vara apparently following bilateral coxa plana, and one case associated with juvenile osteoarthritis deformans. He concludes that coxa plana may be due to trauma, chronic infections (syphilis or tuberculosis) or unknown affections, perhaps of the glands (endocrine).

Guibal reports a case of a man of 29 years who complained of acute attacks of pain in the right hip, lasting 8-10 days, the first attack at 17 years, and then no more until he was 28 years of age. Examination revealed an egg-sized tumor in the ilio-pubic region. The tumor was of bone and fixed to the pelvis. X-ray of the head of the femur showed it to be enlarged and mushroom-shaped. He considered the origin of the coxa plana to be the same as that of the exostosis: in the nature of a dystrophy appearing in adolescence; the flattening of the head being due to the body weight.

Moreau reports a case in a boy of 12, which is atypical in that it began at 10½ years with acute onset and severe pain, keeping the boy in bed a month and a half. At the end of this period he left his bed and walked without pain, and the condition pursued the typical indolent course. X-ray showed typical flat head, but also irregularity in the roof of the acetabulum. This case suggested infection by an attenuated organism.

Van Neck presents two cases of adult men subject to attacks of pain in the hip. X-rays showed femoral heads enlarged and flattened and the acetabula very shallow, resembling old congenital hip. He believes that these deformities are the result of an arthritis.

Delcroix presents a case occurring in a boy of 16 years, in which the symptoms were of abrupt onset and very severe pain. He compares this case with the coxa plana occurring in childhood. (This case is not really a coxa plana, but is a typical adolescent coxa vara). The pain is believed to be due to the deformity; hence the latent period in coxa plana in children. He regards the

condition as an osteitis, having an infantile and adolescent type with all gradations, depending upon the amount of ossification of the epiphysis.

Delchef presents a typical case of coxa plana which one and a half years later showed osteophytes around the border of the acetabulum. He regards the condition as an infection. (Not tuberculosis).

From the above symposium it is evident that in the present state of our knowledge coxa plana, Legg's disease, etc., are terms used to designate a certain anatomical change in the hip rather than a definite disease entity, and that even on the basis of the pathologic anatomy as revealed by the x-ray picture there is wide difference of opinion among various authors as to just what conditions can be included in this category. It is probable that a wide variety of pathologic influences may produce the pictures now rather loosely grouped as coxa plana. It is possible that future observations of cases followed for many years may enable us to separate out a dominant group as a definite disease entity with a definite cause and a definite prognosis, and several subsidiary groups which resemble coxa plana but are due to different etiologic factors and have different prognosis.—*J. A. Key, Baltimore.*

News Notes

Dr. J. Albert Key has recently moved to Baltimore, where he is engaged in the practice of orthopaedic surgery exclusively. He is connected with the University, the Hebrew, and the Kernan Hospitals of Baltimore.

Dr. Robert B. Osgood of Boston has been appointed the John B. and Buckminster Brown Professor of Orthopaedic Surgery at the Harvard Medical School and Chief of the Orthopaedic Clinic at the Children's Hospital, Boston.

Dr. Osgood has resigned as Chief of the Orthopaedic Clinic at the Massachusetts General Hospital.

Professor Henry Turner, of Petrograd, Russia, a corresponding member of the British Orthopaedic Association, would be grateful for the gift of reprints on orthopaedic subjects.

We append herewith a letter recently sent by Prof. Turner to Mr. Elmslie, the Honorary Secretary of the British Orthopaedic Association.

Petrograd, Bascynaya 15.

Dear Dr. Elmslie:—

Offering my cordial thanks to you for the kind invitation to the Annual Meeting of the British Orthopaedic Association, I beg you to be my mediator before the President of the Association in expressing my grief at not having been able to take part in the work of the Association. It is only lately that our connection with the outer world is being permitted. I sincerely hope to renew my ties with the much esteemed Society in a short time. You would do me a great favor if you could, with the Society's permission, send me

some printed material which would help to restore my knowledge of the progress of the western world in Orthopaedic Surgery. Any trifle would be accepted with gratitude.

Begging you to express my feelings of profound esteem to Sir Robert Jones and the Society, I remain with greatest respect,

Yours truly,

Professor Henry Turner.

The Section in Orthopaedic Surgery of the New York Academy of Medicine, of which Dr. Robert E. Humphries is Chairman, and Dr. Sigmund Epstein is Secretary, has held two meetings this season, with the following programmes:

Meeting, Friday evening, October 20, 1922.

PRESENTATION OF CASES.

From Bellevue Hospital:

a. Hemorrhagic Osteomyelitis of the Femur, two years after operation. Thos. A. Smith, M.D.
b. Torticollis.
c. Tuberculosis of the Knee with good function, 18 months after removal of diseased bone from joint.
d. Fusion of Extensor of great toe to Common Extensor of toes, for relief of drop toe.
e. Twist of Femur to prevent dislocation of Hip-joint following Infantile Paralysis.
f. Scoliosis following Spinal Fusion in a case of Fractured Spine.
g. Operation for relief of Ankylosis of Jaw, following fracture.
h. Operation for relief of Ankylosis of Radio-Ulnar joint.
i. Osteotomy of Femur and Tibia for relief of deformity causing pain in back, due to short leg. Reginald H. Sayre, M.D.

From St. Luke's Hospital:

j. A case of Achondroplasia with multiple lesions. Howard Urquhart, M.D.
k. Fracture of Cervical Vertebrae. Henry Scott, M.D. (*by invitation*)
l. Bilateral Epiphysitis of Hip in an adult. Frederick J. Matthews, M.D.
m. Chondrodystrophy of Hip, with surgical treatment. T. Halsted Meyers, M.D.

PAPER OF THE EVENING.

"Treatment of Obstetrical Paralysis." Illustrated by Lantern Slides.

James Warren Sever, M.D., of Boston (*by invitation*)

DISCUSSION.

Meeting, Friday evening, November 17, 1922.

PRESENTATION OF PATIENTS AND REPORTS OF CASES.

a. Full report of case of Fracture of Spine, presented by Dr. R. H. Sayre at the October meeting. Herman L. Von Lackum, M.D. (*by invitation*)
b. A cured case of Congenital Club Feet. Treated by corrective dressings.
c. Infantile Paralysis; leg useless for 18 years; operation and results. Charles Ogilvy, M.D.

e. Joint Mice in the Knee.
f. Joint Mice in the Elbow. Fred H. Albee, M.D.
g. Spondyloschisis.
h. Fragilitas Ossium. Samuel Kleinberg, M.D.
i. Three types of foot stabilizing operations. Elmer P. Weigel, M.D.
j. Operative fixation of Spine for Scoliosis. Barclay W. Moffatt, M.D.
k. Congenital absence of ribs, resulting in a marked Lateral Curvature. Mark Cohen, M.D. (*by invitation*)

DISCUSSION.

PAPERS.

a. "Operative Treatment of the Residual Paralysis of Poliomyelitis." Leo Mayer, M.D.
b. "Rehabilitation of the Cripple." Illustrated by Lantern Slides. John Faries, M.D. (*by invitation*)

DISCUSSION.

The Annual Meeting of the British Orthopaedic Association took place in London on October 20 and 21, 1922. Sir Robert Jones, K.B.E., C.B., presided. The programme was as follows:

Friday, October 20.

MORNING SESSION.

(At the Royal Society of Medicine, 1, Wimpole Street, W. 1).

9:30 a.m. Executive Meeting.

10:00 a.m. Short Papers:—

1. "Tumours of Tendons and Tendon Sheaths." Mr. St. J. D. Buxton.
2. "Results of Tendon Transplantation for Intrinsic Hand Paralysis (Ney operation)." Mr. J. G. Johnstone
3. "Köhler's Disease of the Tarsal Scaphoid." Mr. E. S. Brentnall.
4. "Notes on Infantile Paralysis." Dr. Levick.
5. "Notes on some Complications of Supracondylar fractures." Mr. W. R. Bristow.
6. "Traumatic Myositis Ossificans in the region of the Elbow." Mr. H. Platt.
7. "Myositis Ossificans." Mr. Alwyn Smith.
8. "Types of Tubercle Bacilli in Surgical Tuberculosis." Mr. G. R. Girdlestone.

AFTERNOON SESSION.

2:00 p. m. At the Royal National Orthopaedic Hospital, Great Portland Street, W. 1.

7:30 p. m. Association Dinner (At the Langham Hotel, W. 1).

Saturday, October 21.

MORNING SESSION.

(At the Royal College of Surgeons, Lincolns Inn Fields, W.C. 2).

10:00 a.m. Exhibition of Pathological Specimens, arranged by Sir Arthur Keith. Discussion on the rarer forms of generalised bone deformities.

Dr. Calot announces his thirteenth annual course in orthopaedic surgery, given at 69 Quai d'Orsay, Paris, beginning the 22nd of January, 1923, and lasting for one week.

The course is for both physicians and students and may be taken in English as well as in French and Spanish. Further particulars may be obtained from Dr. Fouchet, Istitute-Calot à Berck-Plage, or from Dr. Colleu, Clinique-Calot, 69 Quai d'Orsay, Paris. The course will be repeated at Berck-Plage beginning the first Monday in August, 1923.

The programme will include the consideration of surgical tuberculosis, congenital and acquired deformities, fractures, and all the newer orthopaedic surgical procedures.

The Society of the Alumni of the Hospital for the Ruptured and Crippled, New York, held its Annual Meeting on November 27 and 28, 1922.

The meeting for the first day was held in the Operating Theatre of the Hospital and the following programme was carried out:

Morning Session.

(1) The Reconstruction Operation of the Hip.
   a. Its Indications.
   b. The Operation.
   c. Post-Operative Results. Dr. Royal Whitman.
(2) a. A New Method of Reduction of Congenital Dislocation of the Hip.
   b. A New Method of Approach for the Removal of the Semilunar Cartilage. Dr. Percy W. Roberts.
(3) Direct Hernia. Dr. J. P. Hoguet.
(4) Wedge Operation for Metatarsal Equinus. Dr. Richmond Stephens.
(5) An Improved Method for Lengthening the Tendo Achillis. Dr. Isadore Zadek.
(6) Demonstration of a New Fracture Table. Dr. Edgar Oppenheimer.
(7) Routine Operations. First Division Staff.

Afternoon Session.

(1) Observations on the Treatment of Simple Fractures. Dr. Charlton Wallace
(2) a. End Results of Open Operation for Congenital Dislocation of the Hip.
   b. A New Bed Extension Apparatus. Dr. Percy W. Roberts.
(3) a. Report of Cases with X-ray Pictures illustrating the difficulties attending the early diagnosis of Sarcoma of the Long Bones.
   b. Patients showing End Results of Conservative Treatment. Dr. William B. Coley.
(4) Cases Illustrating Healed Bone Tuberculosis. Dr. Brainerd Whitbeck.
(5) A Case of Multiple Skin Graft. Dr. C. G. Burdick.
(6) Extirpation and Replacement of the Astragalus. Result at the end of fourteen months. Dr. William L. Sneed.
(7) Three Cases of Spondylolisthesis. Dr. Samuel Kleinberg.
(8) End Result of a Subcapital Fracture of the Neck of the Femur. Dr. Armitage Whitman.

(9) Orthopaedic Conditions following operations for Breast Amputation. Dr. Frank Adair.
(10) Result of Operation for Ruptured Quadriceps. Dr. Isadore Zadek.
(11) Unusual Tuberculous Disease of the Spine. Dr. Balensweig.
(12) a. Torsion of the Testis treated by Operation. Testis Saved.
b. Acute Haemorrhagic Pancreatitis. Operation and Recovery. Dr. Bradley L. Coley.

The meeting on the second day was held at the New York Orthopedic Hospital, and there the programme consisted of:

(1) The Pre-operative, Operative and Post-operative Treatment of Rotary Lateral Curvature of the Spine. Dr. Russell A. Hibbs.
(2) Demonstration of Cases by Members of the Staff.

The Eastern States Orthopaedic Club met at Toronto, November 24 and 25, 1922. The programme was as follows:

Friday, Nov. 24. Hospital for Sick Children.

Osteomyelitis. Professor C. L. Starr.
Living Sutures. Dr. W. E. Gallie.
Calcium in Bone Regeneration. Dr. F. F. Tisdall.
Clinical Cases. Dr. Bruce Robertson.
Fracture of Femur. Dr. A. B. LeMesurier.
Clinical Cases. Dr. Bruce Robertson.
"Insulin" in the Treatment of Diabetes. Dr. F. G. Banting.
Bone Grafts and Bone Pegs in Fractures. Dr. D. E. Robertson.
Operation for Slipping Patella. Dr. W. E. Gallie.

Saturday, Nov. 25. Christie Street Hospital.

Late Results of Tendon Transference.
Amputations.
Flail Joints and their Treatment.
Compression Fractures of the Spine.
Spondylitis.
Endarteritis Obliterans. Professor C. L. Starr.
Late Results of Nerve Injuries.
Heliotherapy in Surgical Tuberculosis.
Pedicle Skin Grafts.
Malunion. Dr. R. I. Harris.

Dr. George Barrie, a member of the American Orthopedic Association, died on October 15, 1922.

The next annual meeting of the American Orthopedic Association will be held in Rochester, New York, on June 7, 8, and 9, 1923.

Book Reviews

Lateral Curvature of the Spine and Round Shoulder. By ROBERT W. LOVETT, M.D., Sc.D., Boston, John B. and Buckminster Brown Professor of Orthopaedic Surgery, Harvard University; Member of the International Society of Surgery; Member of the British, French, Italian, and American Orthopaedic Societies; Member of the Swedish Society of Medicine; Member of the Royal Society of Physicians of Budapest. Fourth Edition. Revised with 172 Illustrations. Philadelphia: P. Blakiston's Son and Co., 1922.

The earlier editions of this book have served for many as a text book on scoliosis and round shoulders or poor posture. An ample insight into the theoretical knowledge of the conditions treated was to be had only by the reading of the book. In this fourth edition an entirely new chapter on the history of scoliosis has been added, and the illustrations have been changed a good deal. The book has been revised with many omissions, but some of the more important chapters, as for instance the final one, have been lengthened.

This last chapter is on faulty attitude, a subject of vital interest, but recognized as such much more in recent times by colleges, municipal administrative bodies, and by the medical profession as a whole. In this chapter the author describes his method of recording faulty attitude, as reported by Reynolds and himself. It is undoubtedly too intricate and expensive a method for the average physiotherapist or physician to use, and probably unnecessary because of the simpler shadowgraph methods now possible for getting the same outline of the body. If more had been written in an endeavor to stimulate a more widespread correction by education of improper, faulty attitude, a condition that is almost general, it would have formed a most welcome addition to this chapter.

The chapter on the treatment of lateral curvature is a calm, sober presentation of the different methods of treatment, with just emphasis on the extreme length of treatment necessary, and also on the importance of coöperation on the part of the patient. Correction by removable jackets, dwelt on by the author more than any other methods, and therefore most likely a reflection of the author's notions as to the better way of correcting certain forms of structural scoliosis, seems to be a time-consuming procedure. Some of the other forms of braces pictured in the earlier editions have been omitted from the discussion because of their displacement by jackets or corsets. The quadrilateral brace worn over a corset is, apparently, the only one recommended.

The most important principle in the book, however, is that of mobilization of the scoliotic spine. It should be obvious that better correction of the deformity would be possible if preceded by mobilizing gymnastics. And, of course, in dealing with patients admittedly physically subnormal, such mobilizing exercises can only be conducive to better general health.

This highly instructive book, with its excellent bibliography, should be of great value to the student wishing for a foundation knowledge of lateral curvature, a condition still obscure to most of us.

Body Mechanics and Health. By LEAH C. THOMAS and JOEL E. GOLDTHWAIT, M.D. Boston: Houghton Mifflin Company. 1922.

Pediatricians and orthopaedic surgeons are encountering a large number of patients in whom no organic lesion can be found, but who, nevertheless, are far from well. An extreme type of such cases would be represented by those whose symptoms may consist of convulsive seizures hardly to be distinguished from epilepsy, and by those who suffer from what is known as cyclic vomiting. There is then another large class of patients who fail to gain weight in spite of most intelligent and careful feeding. It has been discovered that many of these patients may be greatly benefited and their health restored by correcting their body mechanics. It is, therefore, very important that these methods of treatment, which are generally not appreciated and the details of which are generally unknown, should be described.

The book by Miss Leah C. Thomas and Dr. Joel E. Goldthwait would seem to fill a great want. Both of the authors have had a long experience in carrying out these corrective methods and are in a position to describe them authoritatively. The book itself is simple in construction and written for the lay as well as for the professional public, and is fully and adequately illustrated.

We believe that an appreciation of these defects and a knowledge of the methods of treatment should be in possession of all those who have to do with the physical education of children of school age, and the exercises described should be made a part of the regular physical education of all children showing these marked faults of posture. The scope of usefulness of the book is, therefore, very great, and we hope that its circulation will be large.

Wanted

A few copies of the January, 1922, issue of the Journal of Bone and Joint Surgery. These will be paid for at the regular rate of $1.35 apiece if sent to

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